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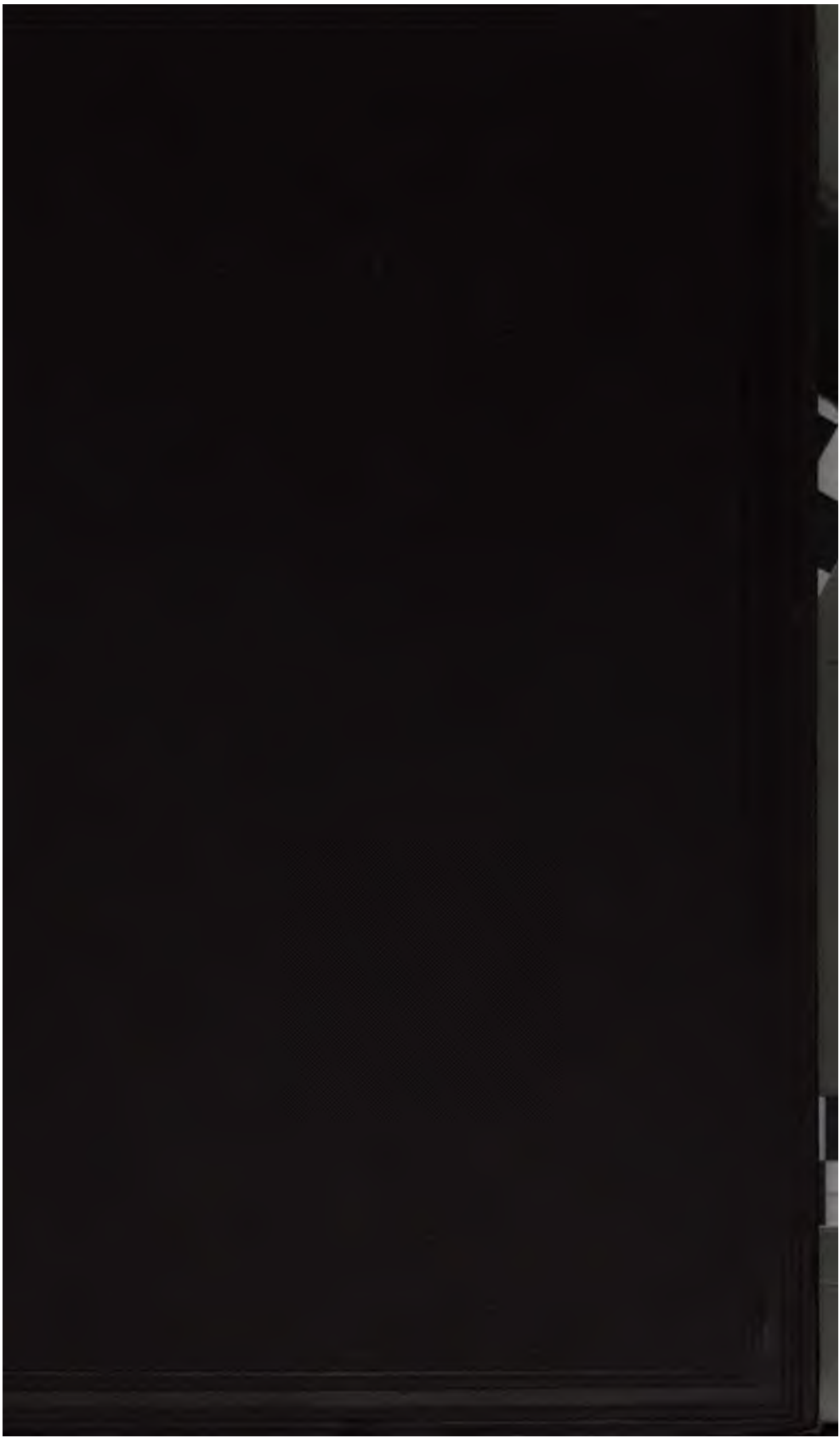

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PROCEEDINGS

OF THE

PHILOSOPHICAL SOCIETY OF GLASGOW.

NINETY-EIGHTH SESSION.

I.—*Arctic and Antarctic.* By WILLIAM S. BRUCE, F.R.S.G.S., with Photographs by the Author.

[Read before the Society, 7th November, 1900.]

IN addressing you, this evening, on the subject of "Arctic and Antarctic" I propose to give you a brief general account of the Polar Regions, both North and South. I propose further to lay before you, at the close of the lecture, the projected plans of the Scottish Antarctic Expedition, which I hope will meet with your consideration and approval.

A complete history of the North Polar Regions would fill many volumes, and for me to give an exhaustive summary of the discoveries that have been made there, and an account of the explorers who took part in evolving the known from the unknown would require several lectures.

Pythéas of Massilia, the Greek navigator and geographer, appears to have been the first to have crossed the Arctic Circle, some three centuries before the birth of Christ, for he has left behind him a description of the twenty-four-hours day and a frozen sea. Irish monks journeyed to Iceland in 825 A.D., and Norsemen founded Arctic Colonies in Iceland and Greenland, nearly a thousand years ago, penetrating north of the 75th parallel of latitude.

The Black Death, in Norway, in 1374, caused these colonies to be lost sight of, and it was not till the end of the 15th century, that Arctic exploration was renewed. The discovery of Muscovy, Kola, Novaya Zemlya, and the Kara Sea by Willoughby and Chan ellor, and the voyages of the brothers Zeni of Venice, and of Cabot, are perhaps the most prominent work of this period; nor must we forget the Dutch voyages under William Barents searching for a N.-E. passage to India and China. Barents dis-

covered Bear Island and Spitsbergen, and was the first to winter successfully in the Arctic Regions, namely in the north of Novaya Zemlya. These voyages of discovery of Barents into the unknown areas of the Arctic Regions, led directly to the prosperous seal and whale fisheries, which so long enriched the Netherlands. The name of Davis must also be mentioned. He was the discoverer of Davis Straits, and the coasts adjacent; nor must we omit the work of Frobisher who, as well as Davis sought for a N.-W. passage.

During the 17th century, the pursuit of trade and exploration was actively carried on in the Arctic Regions. Hudson, for instance, made discoveries in Greenland, Hudson Strait and Bay, Jan Majen, Novaya Zemlya, and Spitsbergen—discoveries which gave rise to the British whaling and sealing trade, so actively carried on by such men as Fotherby, Baffin, Joseph, and Edge. These men, while plying their trade, made geographical discoveries. The whale and seal fisheries were so lucrative, that Britain attempted to obtain the monopoly of them. But Holland resented, and hostilities broke out in 1618 in which the Dutch defeated the British and remained supreme till 1770. At this time the Dutch alone had 260 vessels, and 14,000 men employed in the trade. I visited the scene of their work in the N.-W. of Spitsbergen, in the summers of 1898 and 1899. Hundreds of graves and skeletons, and the ruins of houses, now form the sole vestiges of this great industry of the 17th and 18th centuries. Behring, Liakhoff, Moore, Coats, Herne, Mackenzie are names one associates with Arctic exploration in the 18th century. Herne descended the Coppermine river, Mackenzie discovered the mouth of the Mackenzie River, Liakhoff the Siberian Islands, Behring, Behring Straits and Mount St. Elias. Nearly 7,000 Dutch voyages were made to the Arctic between 1700 and 1775 and only 38 vessels were wrecked. After 1770 the British whale fisheries developed at the expense of the Dutch, and in 1778 no less than 255 British ships were sailing in the Arctic. Scoresby, of Peterhead, is one of the most striking figures of the 19th century, both as a trader and as a scientific explorer. Barrow, Parry, Franklin, who completed the North-West Passage, Lutke, Back, Simpson, M'Clure, and scores of others, whose work and names you are thoroughly familiar with, represent the earlier part of this century. While Nordenskiold, Nansen, Peary and the Duke of the Abruzzi stand out in the foremost ranks of the recent Arctic explorers. Two others, with whom I have been

personally associated, have recently undertaken valuable hydrographical and oceanographical work in the north polar regions, with results of the greatest interest. I refer to the Prince of Monaco and Mr. Andrew Coats of Paisley. In the realm of hydrography and oceanography, Nansen, Nathorst, and Makarof have also done yeoman service.

From these few remarks you will be able to understand how hopeless it is to attempt even a short summary of the History of the Arctic Regions. It is, however, not so difficult to summarize the history of discovery and research in the Antarctic Regions, since so little has been done there. To Peru belongs the honour of sending out the first Antarctic Expedition, more than three centuries ago. In 1567 the Governor sent out an expedition under the command of his nephew, Alvaro Mendaña, to discover "Terra Australis Incognita." A second Peruvian expedition was sent out in 1605, and discovered an island of the New Hebrides group in 1606.

Dirk Gerrits in the meantime, in 1598 had set sail from Amsterdam, accompanied by a small fleet, and while separated from his companions by heavy weather, near the Straits of Magellan, discovered some high land now known as the South Shetlands. Gerrits and his crew were eventually captured by Spaniards. France was next in the field, La Roche discovering the island of South Georgia in 1675, and Kerguelen in 1772 what he at first believed to be the Antarctic continent, but what he found to be only a small island on returning in the following year. This island now bears his name. Britain, however, was the first nation to do any real work in the Antarctic, and that work is associated with the name of Captain Cook. He was the first to cross the Antarctic Circle, in 1773, and, crossing it again in 1774, he attained as high a lattitude as 71° 15′ S. In a second voyage he circumnavigated the globe in high southern latitudes, twice crossing the Circle, and was thus the first to confine the Southern continent within the Antarctic Circle. Cook described the terrors of these inhospitable regions, and firmly believed that no higher southern latitude could ever be attained. In 1819 William Smith of Blyth rediscovered the South Shetlands, the discovery being confirmed by Bransfield in the following year who also sighted Bransfield Land. In 1820, Bellingshausen crossed the Antarctic Circle, and crossed the latitude of 70° 15′ S. in 1° 30′ W.; he also discovered the Peter and Alexander Islands,

then the most southerly land known. In the following year Powell discovered the South Orkneys. In 1823 our brave and distinguished countryman, Captain James Weddell, beat all former records, sailing as far south as 74° 15′ S. in 34° 17′ W. Here, on the 20th of February, he found a sea clear of field-ice, with only three icebergs in view. Two days previously, two degrees farther north, Weddell says, "In the evening we had many whales about the ship, and the sea was literally covered with birds of the blue petrel kind; NOT A PARTICLE OF ICE OF ANY DESCRIPTION WAS TO BE SEEN."

John Biscoe, in the service of Messrs. Enderby, twice effected a landing; he was the first to put foot on land within the Antarctic Circle. This was on Adelaide Island in 1831. It was he who discovered the western coast of Graham's Land, the Norwegians and ourselves first seeing, in 1892 and 1893, the eastern coast. Several other masters sailing under Messrs. Enderby made discoveries, notably Balleny, who discovered the Balleny Islands and Sabrina Land. After these come D'Urville the Frenchman, Wilkes the American, and Ross, our own countryman, who laboured during the years 1839 to 1843. The only expeditions that have explored the Antarctic Regions since 1843, with the exception of the Challenger's flying visit in 1874, are those that have sailed during the last eight years. I was fortunate enough to accompany the first of these, which sailed from Dundee, in 1892, and was absent for nine months. Since that time the names of Larsen, Gerlache, and Borchgrevink have been more particularly associated with the work. To Lieutenant Gerlache, of the Belgian Expedition, belongs the honour of first spending a winter in the Antarctic Regions, and subsequently Borchgrevink has also borne the hardships of a South Polar winter on the land.

But of all expeditions to the Antarctic, that of the "Erebus" and "Terror," under the command of Sir James Clark Ross, during the years 1839 to 1843, is by far the most remarkable and important. With indomitable courage and perseverance, Ross crossed the Antarctic Circle in three successive years. On two of these occasions he attained far higher latitudes than any of his predecessors. He discovered Victoria Land, the vast mountainous tract extending away to 70° S. in the longitude of New Zealand, and terminating in Mount Erebus, which, from a height of over 12,000 feet, lights up the winter darkness of the snowy desert.

SPITSBERGEN.—TRURENBERG BAY.
Showing Swedish Station, S.Y. "Svenkshund," and S.Y. "Princesse Alice"

SPITSBERGEN.—RECHERCHE BAY.
View across the Valley from N.-E. to S.-W.; Goose Pond in foreground.

From this point, in about 78° S., he sailed along the icy barrier running eastward for 300 miles, the termination of the ice-cap of the great Antarctic continent. In 1842-43 he visited the region of Erebus and Terror Bay, lying to the South of Cape Horn, and became entangled in impenetrable pack-ice; pushing farther eastward, he again crossed the Circle, attaining a latitude 71° 30′ S., between Bellingshausen's and Weddell's tracks. Ross believed he could have landed and travelled over the continent.

"To the north-westward," says Ross, "we observed a low point of land with a small islet off it which we hoped might afford us a place of refuge during the winter, and accordingly endeavoured to struggle through the ice towards it, until 4 p.m., when the utter hopelessness of being able to approach it was manifest to all, the space of fifteen or sixteen miles between it and the ships being now filled up by a solid mass of land ice. . . . . .

"Had it been possible to have found a place of security upon any part of this coast, where we might have wintered in sight of the brilliant burning mountain, and at so short a distance from the magnetic pole, both of these interesting spots might easily have been reached by travelling parties in the following Spring. . . . . It was nevertheless, painfully vexatious to behold, at an easily accessible distance, under other circumstances, the range of mountains in which the pole was placed, and to feel how nearly that chief object of our undertaking had been accomplished; and few can understand the deep feelings of regret with which I felt myself compelled to abandon the perhaps too ambitious hope I had so long cherished of being permitted to plant the flag of my country on both the magnetic poles of our globe."

With steam Ross would undoubtedly have accomplished what, with a sailing vessel, was quite impossible.

D'Urville and Wilkes both did good work, and discovered land south of Cape Horn and South of Australia in high latitudes.

The part of the Antarctic, which I visited, was that lying to the south of South America, and to the east of Graham's land in the region of Erebus and Terror Gulf. I was accompanied by my friends, Mr. W. G. Burn Murdoch and Dr. C. W. Donald. We took berths on the "Balæna" and "Active," two of four Dundee whalers which were going South to try the resources of the Antarctic seas for whaling and sealing, since the Arctic of late had proved unremunerative. Burn Murdoch went as artist, Donald as medical officer and naturalist, and I went as naturalist.

The combined results of our work have been given to the Royal Scottish Geographical Society, Royal Geographical Society, the British Association, and other learned societies. For more than three months we were continually in the ice, cruising over 4,000 miles hither and thither; and besides this there was the long voyage there and back of 15,000 miles, which took us six months. It is this long and expensive voyage that has, no doubt, been a hindrance to the exploration of the Antarctic, as it is impossible to make shorter summer cruises such as are made to the Arctic Regions.

Captain Larsen, who sailed with us, made a second voyage, the following season, and extended our discoveries to the southward.

The Belgian Expedition, under Gerlache, explored to the west side of Graham's Land, the Eastern side of which we worked along. This Belgian expedition was the first completely equipped, purely scientific expedition that explored in the Antarctic since the time of Ross. They carefully mapped out a large tract of the west coast of Graham's Land, which was practically unknown, and landed at several places. Afterwards Gerlache and his companions pushed into the pack to the south-west, and being caught and frozen in, were compelled to winter there in a most perilous position. The Belgian Government are giving aid to work up the results of their observations, and some time must elapse before the reports are complete. We know, however, that this plucky Belgian expedition has achieved great results in geology and ice-work, in oceanography, in biology, and meteorology.

Mr. Borchgrevink will lecture in Glasgow next week. I prefer therefore to let you hear his story from his own lips No doubt the scientific results of his expedition will add very greatly to our knowledge of the Antarctic Regions.

The short time at my disposal permits me to give but the merest outline sketch of these distant realms of ice. In the first place let me refer you to these two charts of the North and the South Polar Regions. There are salient differences between these two remote parts of the world. In the north, as you observe, there is a polar sea surrounded by land; whereas in the south there is a great land area surrounded by sea. This configuration gives rise to quite a number of other differences, especially in relation to meteorology and magnetism. The North Polar Regions, on account of the enormous surrounding land masses, possess a continental climate, which is especially emphasised in winter when

the sea ice is continuously unbroken. For this reason one expects colder winters in the north than in the south, even perhaps colder than in the heart of the continent of "Antarctica" itself; and similarly, the summers should be less intense in the Antarctic regions than in the Arctic regions. This appears to be borne out by the observations of Donald and myself, taken in the summer of 1892-93, and those of previous and subsequent observers. In December, January, and February, we found only a difference of 16.8° F. between maximum and minimum temperatures, the minimum being 20.8° F. and the maximum being 37.6° F. Compare this with our own climate, when in a single day you may get a variation of more than twice that amount. The average temperatures were still more remarkable. December averaged 31.14° F., January 31.10° F., February 29.95° F., a range of less than 1½° F. The minimum winter temperature registered by Gerlache and Borchgrevink was about 45° F. or 77° of frost. This temperature is not very low, corresponding with the minimum temperature I experienced in Franz Josef Land, during the winter of 1896-97, where, on account of the influence of the Atlantic and the Gulf stream, a prevailingly oceanic climate exists in this part of the Arctic Regions. No intense cold such as exists in the centre of the N.E. of Asia, and the north of North America, has been recorded in the Antarctic, or is likely to be recorded, in my opinion, even in the heart of the Antarctic Continent itself, even at a great elevation on the ice cap. The lowest winter temperature ever recorded was at Verkhoyansk, just north of the arctic circle in 1886, namely—89° F. or 121° of frost. This the lowest temperature ever experienced by human beings in the north I do not believe will be equalled, certainly not surpassed, in the south.

One striking feature of the Antarctic is, that between 60° and 70° south, there is a belt of very low pressure—the lowest mean barometric readings in the world being recorded there. It is a belt of storms and heavy precipitation, and this heavy snowfall gives rise to another remarkable feature of the Antarctic, namely excessive glaciation and enormous icebergs. I shall say more of these when we come to project the pictures on the screen from the beautiful paintings of Burn Murdoch, and from my photographs. We shall then see the difference in the nature and size of these bergs compared with those of the Arctic. I shall show you pictures of arctic glaciers and of the great ice wall that Ross dis-

covered and mapped out—one of the great outlets of the enormous ice cap of Antarctica. To the south of this belt of low pressure the barometer appears to rise again, and the winds appear to blow outwards from the pole, probably indicating that anticyclonic conditions prevail round about the south pole and over the great continent. We should therefore expect in this region, finer, calmer, and clearer weather, and relatively low temperatures, and less precipitation than in the outer belt.

There has always been a theory of an antarctic continent, but until the time of Ross we had no conclusive evidence of the fact Ross discovered about 1,000 miles of antarctic coast line and ice wall, thus proving that there was a great mass of land round about the south pole. Sir John Murray, our greatest antarctic authority and oceanographer, has further demonstrated the existence of an antarctic continent, and has ventured even to roughly map its outline and to estimate its area. His conclusions are based ona careful study of the depths of the oceans and of the deep sea deposits. Murray estimates the area of the Antarctic Continent as approximately the size of Australia, namely about 4,000,000 square miles.

* "During the Challenger expedition, transported fragments of continental rocks were never found towards the central portions of the great ocean basins in tropical and sub-tropical regions. The only rocks dredged from these areas were fragments of pumice or angular rock-fragments of volcanic origin. In the Central Pacific, however, as the fortieth parallel of south latitude was approached—therefore just beyond the limit to which Antarctic icebergs have been observed to drift—a few rounded fragments of granite and quartz were dredged from the bottom of the sea; similar fragments were obtained in the South Atlantic, in high latitudes, and as the Challenger proceeded towards the Antarctic circle in the South Indian Ocean, these fragments of continental rocks increased in number till, at the most southerly points reached, they, along with the mineral particles and muddy matter derived from continental land, made up the larger part of the deposit. These fragments consisted of granites, quartziferous diorites, schistoid diorities, amphibolites, mica schists, grained quartzites, sandstone, a few fragments of compact limestone, and partially decomposed earthy shales. These lithological types are distinctly indicative of continental land, and remembering what

* *Vide* Geographical Journal, Vol. III. No. I., January, 1894.

has just been said as to their distribution, it seems wholly unnecessary to refute the suggestion that these fragments may have been transported from the northern continents.

"Glauconite is another mineral which was procured in the blue muds near Antarctic land. This mineral fills the shells of foraminifera and other calcareous organisms, and has been found in the muds along nearly all continental shores where the debris of continental rocks makes up the greater part of the deposit. Glauconite is now in process of formation in all these positions, but it is apparently wholly absent from the pelagic deposits of the great ocean basins far from continental land, as well as from the deposits around volcanic islands. Its presence in the blue muds of the far south is therefore most suggestive of an Antarctic continent.

"When we come to estimate the extent of the sixth continental area, greater difficulties are presented. A knowledge of the depths of the surrounding ocean would enable the outlines to be drawn with great exactitude, but unfortunately the positions where accurate soundings have been taken are few and far between. In the South Pacific, South Atlantic, and South Indian Oceans, between the latitudes of 30° and 50° south, we have most excellent lines of soundings right round the world, and in these latitudes the average depth of the ocean is over 2,300 fathoms, or about 2½ miles. Between the latitudes of 50° and 65° south, the indications we possess appear to show a gradual shoaling, with the average depth of about 1,700 fathoms, or nearly 2 miles."

Murray has been criticised for showing on bathymetrical charts a great depth in the Southern Ocean to the S.W. of South Georgia. It may be pointed out, however, that this configuration of the floor of the ocean is borne out by the sounding of Ross, "4,000 fathoms, no bottom," and more recently still by the German ship *Valdivia*, which has taken soundings in the neighbourhood, supporting Murray's hypothesis.

What we saw of Antarctic land was entirely snowclad, except on the face of precipitous slopes, where snow could not lie, and on what appeared to be raised beaches, which were in most cases the resort of penguins. The rocks gathered by Donald and myself were all basic, containing olivine, and were chiefly basalts and gabbro. On Seymour island were secured the first fossils ever found in the Antarctic. They appear in all probability to be Tertiary fossils, and are of much interest from a geological point

of view. They include five species of Cucullea, one of Cytherea and one of Natica, and two are pieces of a conifer. All these fossils have a wide distribution in time, and consequently tell little as to the precise age of the rocks, but probably they belong the Lower Tertiaries, and are of the same age as those recorded by Darwin and Baker from Patagonia. On the west coast of Graham's Land the Belgians found nothing but plutonic igneous rocks.

So far Borchgrevink has not stated whether he secured any fossils at Cape Adare or elsewhere, where he landed in Victoria land, although apparently sedimentary rocks were met with. While making soundings in the vicinity of Graham's Land, I brought up to the surface, specimens which indicated the presence of metamorphic and also sedimentary rocks.

Those parts of Antarctica that are not ice-clad attain an extremely high altitude. In Graham's land, for instance, Mount Hamilton rises as an exposed rugged peak of over 7,000 feet. In Victoria Land we have still higher mountains, which, according to Ross, attain the altitude of 15,000 feet. We have very good reason for believing that the Pacific coast of Antarctica possesses a chain of active and extinct volcanic cones including Mount Erebus, Terror, and Melbourne, which are "a continuation of that vast chain of volcanoes which more or less completely surrounds the whole Pacific, facing, so to speak, the circle of Continental land looking out on that great ocean basin."

The temperatures of the Antarctic Seas as compared with those of the Arctic, offer some striking features. In the isolated Arctic basin, a uniform temperature of about 29° F., is found all over the floor of the ocean. But in the Southern Ocean at the greater depths a temperature is found somewhere between 32° and 34° F. as far South as the Antarctic Circle, and not therefore very different from the temperature of the deepest bottom water of the tropical regions. The presence of this relatively warm water in the deeper parts of the Antarctic Ocean may be explained by general oceanic circulation, but time will not allow me to enter into further details.

The Antarctic land is to all intents and purposes devoid of life, there being only a few recently discovered mosses and lichens. Sea birds, such as penguins and petrels, nest along its shores in countless numbers, and some smaller invertebrates, including a single insect have been recorded.

But in the Antarctic Ocean there is a great profusion of life,

both animal and vegetable. "Myriads of tetraspores give the sea a green colour. Diatoms are in such enormous abundance that tow-nets are filled to the brim with a yellow brown slimy mass, with distressing odour, through which various crustacea, annelids, and other animals wriggle."

"The marine algae are the primary source of food in the sea, and their great development in the Antarctic Ocean leads to a corresponding abundance of animals. Occasionally vast quantities of Copepods, Amphipods, and Shizopods are observed, which give the ocean a reddish colour; and sometimes fine tow-nets burst with miraculous drafts. These small crustacea form the food of fishes, penguins, seals, and whales, which are in consequence found in great hosts in these Southern Latitudes." Out of nine trawlings and dredgings south of 43rd parallel in depths over 1,200 fathoms, the Challenger took 830 animals (excluding Protozoa). These represented 398 species, of which 326 were new to science. One hundred and sixty two species of these were found in no other part of the ocean, and these again included 8 new genera, and 56 new species of echinoderms. An interesting biological problem is to be found in the question as to whether we can trace any shallow shore antarctic forms, from which these hosts of pelagic and deep sea forms have originated.

This is a very rapid review of what we at present know about the Antarctic Regions, and I shall now throw some pictures on the screen to illustrate and supplement what I have already said.

I shall ask you to bear with me for a few minutes more in order to tell you something about the different plans that are at present on foot to explore more efficiently the South Polar Regions, the greatest unknown area of the earth's surface.

I have given you a general outline of the Polar regions—more especially referring to the South. You will have gathered that we have much to learn yet from these two most interesting portions of the earth's surface, and that it is highly important that we should carry on further investigations there. In view of this, before I take leave of you this evening, I should like to refer briefly to a new project, viz., the proposed other Scottish National Antarctic Expedition. Two other important expeditions are being fitted out to explore the Antarctic regions in 1901. One of these sails from Germany, the other from Britain. It is not at all

possible that these two ships can explore the whole of the Antarctic regions, where we have an area greater than that of Africa, about which we practically know nothing. Many authorities have advocated the necessity of sending a second ship from the British Isles. Professor Erich Von Drygalski, leader of the German Expedition, has pointed out that "an expedition from a third side would find a wide and important field of activity to the south of South America."* It is now proposed that this third expedition should sail from Scotland; it will co-operate with the two other expeditions, and devote its attention more especially to physical, biological, and oceanographical researches, and to geology and meteorology. I must refer you to the "Scottish Geographical Magazine"† for a full account of the work of this expedition. But briefly the plans are as follows:

To make the Falkland Islands the base, and then to push southward in 30° W. longitude, where in 1823 Weddell attained as high a latitude as 74°.15′ S. It is hoped that land will be reached in latitude 80° S., but if not, a course will be steered westward to strike the extension of the eastern coast of Graham's Land. Land being reached, a wintering station will be set up, fully equipped for scientific research, and the ship will then retire northwards. During the winter and spring, the staff at the station consisting of seven men, will carry on systematic scientific observations, and will make sledge journeys for topographical, geological, and other work, both along the coast and into the interior. The ship meanwhile will be carrying on oceanographical researches in less high southern latitudes. In the early summer the ship will again push southward and visit the station and as far as the season allows, will do exploring work in its vicinity. A second winter will be spent in a similar way, and if funds allow a third one also, after which the expedition will return home. One of the many points of special scientific interest will be the investigation of the deepest known portion of the Southern Ocean, which lies in the track of the expedition.

The cost of the expedition on the lines indicated above, will not exceed £35,000, of which about £10,000 has already been secured. It rests with those interested to decide whether or not this expedition is to leave Scottish shores.

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*"Nature," Vol. LXI., No. 1579, 1st February, 1900.

†*Vide* "Scottish Geographical Magazine," June, 1900, for full details of the plans of the expedition.

II.—*A Boer Admirer of Robert Burns.* By JAMES COLVILLE, M.A., D.Sc., President of the Philological Section; a contribution from the Philological Section.

[Read before the Society, 21st November, 1900.]

FOR almost a century now the Dutch Afrikander has been practically cut off from his ancestral home in Holland. Doubtless his church, its Bible, and its preachers, have served to keep unbroken a chain of communication, ever lengthening by time and distance, and this kind of influence must have told specially in language. But both the religion and the language have undergone a much more rapid change at home in Holland than out on the sparsely-peopled Veldt of South Africa. The consequence is that both are old-fashioned and homely, and therefore admirably suited to the mental and spiritual attitude of the pastoral Boer. With a creed that has ceased to develop, and without a home-grown literature, he has clung all the more fondly and tenaciously to the antique vernacular which he has inherited from his forefathers. He calls it lovingly *die ou'we* or *oude Taal*, using, to name it, the root we have in tell and tale. In German still, and in English of old, it meant to count, but the operations of reading and counting in many languages appear readily to overlap and commingle. The Taal scarcely deserves the hard words that have been applied to it as a barbarous and uncouth polyglot. The Scot can well sympathise with such treatment, for the Englishman, disdaining to try to understand his dialect, calls it unintelligible, vitiated English, and when he does condescend to make a *lever de rideau* out of it, mangles it through his perverse habit of mispronunciation. The Dutchman looks upon the Taal in much the same light. An intelligent Hollander writes me thus:—"I hate and detest the Boer idiom, which is a repulsive amalgam of old and modern Dutch, with traces of Platt-Deutsch and English, and only good, or rather bad enough, to disappear from among the races of mankind." This is of value, merely as emphasising my point, that the appreciation of vernacular is incompatible with the attitude of what arrogates to itself a claim to

progress and culture. The Taal has merely undergone natural changes on old lines, but less rapidly than Dutch. It has borrowed a little from English, and almost less from Kaffir, for no people ever learns much from a race on a lower plane of culture than its own, though the two may be commingled. The Highlander and Lowlander have always had very close intercourse at many points, but English and Scotch borrowings in Gaelic vastly outnumber Gaelic terms in Scotch or English.

The Taal, or Kaapsche, as the Hollander calls it, has closer affinities with Lowland Scotch than with any other European tongue, except Dutch. The resemblance to German is mainly superficial. Certainly the philologist is constantly reminded of German in studying the Taal, but the uneducated Boer or German speaker would quite overlook this, for their consonantal systems are entirely different. On the other hand, the Frisian speech was, in very early times, common to the eastern and western shores of the North Sea, and these shores were more nearly opposite, and united therefore more closely by trade, on the side of Scotland than of England. In addition, the two peoples enjoyed substantially the same Calvinistic type of church, a type which has been even better preserved in South Africa than in either Scotland or Holland. Certainly, during the first half of last century, a Scotsman would find himself vastly more at home in Leyden, Rotterdam, or Amsterdam, than he would in London, or even Newcastle. The Boers themselves are well aware of this bond of union. The German overseer in Olive Schreiner's "Story of an African Farm," tells the knave, Blenkins, when introducing him to the Boer woman, Tant Sannie, to call himself a Scotsman. The English she hates.

Mr. Reitz, the luckless ex-secretary of the Transvaal, enjoyed an English education, but seems to have returned to his home on the Veldt a confirmed separatist. His sense of patriotism, deepened by his sojourn here, led him to do for his brethren what King Alfred did for his Englishmen, and that was to supply them with a native literature, or at least a temporary substitute for it. He knew well that nothing so supports the flame of patriotism as pride in the national speech. This was in every way laudable. Krugerism, on the other hand, when it imposed Dutch on the Uitlanders, was simply narrow-minded tyranny and separation of the worst type. Reitz rightly tried to foster a popular literature, and so he chose for the models he put before the young Boers

such pieces as "John Gilpin," and above all the poems of Burns. They were published, fifty in number, in 1888, when he was Chief Justice of the Orange Free State. Of these pieces the outstanding ones are "The Cottars," "Tam O'Shanter," and "Duncan Gray." They are suggestions more than translations. With skill and judgment he selects the features that suit the Boer environment, and adds many touches that spring out of the changed situation. All of them throw most interesting light on the peculiarities of the people. In the "Cottars" Reitz admirably illustrates the rural homeliness and isolation of Boer life, combined with characteristic social and devotional traits. "Tam" shows the Boer in convivial mood, the victim at once of good fellowship and uncanny spooks. He cheats the devil through his slimness and mobility. In Duncan Gray again, we have the Boer in the lighter vein of a wooer or vrijer, a term that is a survival from pre-historic times, for it is just the masculine of the Freja or Norse Venus of our Friday or Freja-day, and still heard in the "trusty freen'" of "Auld Langsyne." In the Gothic gospels of the fourth century, frijon, to love, is common, while our Lord is generally addressed as Frauja. The wooer is the young farmer, Daantjie or Danie Grouws (*cp.* Ger. grau, grey), while the wooed is the meisje (missie), Maartjie or Martha. The Boer has all an Aberdonian's fondness for diminutives. As we have all been picking up scraps of Boer words from the table of the war correspondents, no apology should be needed for presenting a specimen of the Taal in its entirety. A word for word translation will enable the reader, with his Burns in hand, to judge of the merits of the piece. It will be noted that, wherever an English word could be found that was closely akin to its Taal equivalent, it has been used though archaic from the modern point of view. The second line, as the oft-recurring refrain, need appear only once.

DAANTJIE GROUWS.*

Daantjie kom hier om te vrij,
Danie comes her for to woo.
Ja, met vrijers gaat dit so,
Yes, 'mid wooers goes it so;
Sondags-aânts het hij vèr moet rij.
Sunday-eves he far must (O.-Eng. mote) ride.

* I found the text of this piece in that unique and interesting collection, "Robert Burns in Other Tongues," by Dr. Wm. Jacks (Glasgow: Maclehose, 1896). For the English translation I am indebted to my esteemed friend, Miss Frances du Toit of Rondebosch, Cape Town, an accomplished Afrikander. The language, though not the sense, I have altered so as to suggest affinity wherever it exists.

Maartjie steek haar kop in die luch,
Martie sticks her head in the light,
Kijk so skeef en trek terug,
Keeks so slyly and draws back,
Sit ver Daantjie glat op vlug.
Sets Danie clean on the wing.
Daantjie smeek en Daantjie bid.
Danie flatters and Danie entreats (*O.-Eng. bid*),
Maartjie's doof en blif maar sit.
Martie is deaf, and remains still (*Sc. mair*) *seated.*
Daantjie such vir ure lang.
Danie sighs four hour long.
Vêe die trane van sijn wang.
Wipes the tears from his cheeks,
Praat van hemselve op te hang,
Prattles of himself up-to-hang,
Die tijd versach maar ons gevoel.
But (*maar cp. Fr. mais*) *time softens our feelings.*
Verachte liefde word ook koel.
Despised love worth (*becomes*) *eke cool.*
"Sal ik," seg hij, "nets (Ger. nichts) een gek,
"*Shall I*," *says he* "*an out-and-out gowk* (*fool*
Om een laffe meisie vrek?
For a laughing lassie be-driven-away?
Sij kan naar die hoenders trek."
She can near the hens go."
Hoe dit kom lat dokters vertel,
How it comes let doctors tell.
Maartjie word siek en hij word wel.
Martie grows sick and he grows well.
Daar's iets wat an haar borsie knaa.
There's something what in her bosom gnaws
En hartjie-seer begin haar plaa,
And heart-sore begins her to-plague,
Haar oogies glinster ook maar braa.
Her eyes glisten eke more bright (*Sc. braw*).
Daantjie was een sachte man,
Danie was a soft man,
En Maartjie trek haar dit soo an,
And Martie took it to her so,
Daantjie krij jammer in sijn hart.
Danie felt pity in his heart.
Die liefde groei weer an sijn part.
Love grew again on his part.
Nou leef sulle same sonder smart.
Now live they together without vexation

The Boer vernacular offers many points for annotation to the curious in matters linguistic. German, as the most archaic living Teutonic speech, is, of course largely represented, witness om = um, met = mit, aânts = abends, glat = glatt (smooth), vir = vier, trane = träne, van = von, sijn = sein, wang = wange, gevoel = gefühl, ons = unser, verachte = verachten, word = werden, seg = sagen, same = zu-sammen, oogies = augen, krij = kriegen. But scarce any of these are unknown to Scotch or old English. Thus while modern English says evening, Scotch shows the same softening as the Taal, witness, "Hame cam oor gude man at een." We have now lost the useful verb, *word* (becomes), but Scott uses it in "Woe worth the hour!" This piece, again, shows two of the commonest words in Cape Dutch that are explained by Scotch and German, though at first sight obscure. These are the positive iets (ocht = ought), and the negative niets (nocht). But the Taal, in following Low Dutch, is consonantly akin to Scotch and English, rather than German, as is shown by comparison of these Boer words with their German cognates:—te = zu, terug = zurück, op = auf, doof = taub, tijd = zeit, ook = auch. We have here also the favourite corruptions of the Taal. Thus a dental, both final and medial, frequently disappears as rij for ride, Ger. reiten, luch for Scotch licht, or weer for German wieder, (*cp.* Eng. with-stand, with-hold,) drif for drift. A similar softening is seen in *vêe* for wipe. Such elisions are common in all linguistic growth. Reitz's language, indeed, shows nothing to justify the popular contempt for the Taal as a vulgar hotch-potch of corrupt Dutch, English and Kaffir.

To the Scot the Taal must always sound familiar, for he can turn an intelligent ear to both the Dutch and the German elements in it. The sounds are often exactly his own. The query, "Hae ye faur te gang?" is just the Boer, "He'you vèr te gaan?" The Boer constantly uses kijk, to look, though in Scotland it is but little heard out of the nursery. In South Africa, however, photographic views are kiekjies, and a field-glass is a ver-kiekjer. Similarly in en for and, een for a and one, ure for hour, and lang for long we are on homely ground. The Scot, again, has ceased to sound the guttural in such (sigh), but to "keep a calm souch," is still for him a discreet silence.

Reitz's rendering is spirited, though we miss some characteristic touches. "On blithe Yule night when we were fou," is discreetly changed so as to suggest the long distances on the

lonely Veldt and the pleasures of the Op-sit on the great social evening of the week. In the very expressive skeef, we have what is really only a variant of the Scotch skeigh. The change of final is paralleled in laugh, enough. Of course Ailsa Craig must go, but while to "remain seated" may be *de rigeur* on such occasions in Boerdom, the change is weak. Nor can the Lover's Leap be always practicable in the sun-dried spruits, so "spak o'lowpin owre a linn" is dropped. "Grat his een baith bleert and blin," is feebly rendered by "wipe the tears from his cheeks." The phrase "een geck" is however stronger than "a fool" of the original. "Hunt'e gowk" is to play April fool. The word is also in the familiar play-rhymes :—

"Nivvi-nivvi-nik-nak,
Which hand will ye tak.
Be ye right or be ye wrang,
I'll be-gowk ye if I can."

"Een laffe meisje" is only a "giglot lassie," a very different thing from a "haughty" hizzie." The sly humour too of "Duncan was a lad o' grace," has been missed in the phrase, a "soft or tender-hearted man." The sach here is a familiar Scotch word for soft, while, contemptuously, sauchie is a simpleton. In the Buchan dialect a selch is a big, stout, daichie or doughy fellow, somewhat after the fashion of the seal. Selch, in fact, is a dialect equivalent for seal, of which it is but the fuller form. On the whole "Daantjie Grouws" is a vigorous and characteristic specimen of the Boer vernacular, and gives a very favourable impression of the translator's literary tastes and sympathies. There remains only to add, that in all the piece under discussion we have but three terms with which the war has made us familiar—kop, trek and ons (our), which last is in the title of the Bond organ, Ons Land.

III.—*Some Points in the Analysis of Meat Extracts and Allied Preparations, with Notes on their Dietetic Value.* Being the results of a series of analyses performed by Professor HUGH GALT, M.B., D.P.H.(Camb.), in the Public Health Laboratory of Glasgow University, during Session 1898-99.

[Read before the Society, 19th December, 1900.]

THE use of condensed and more or less liquid preparations of meat, in the dietary of invalids especially, has only come into prominence within comparatively recent years, although "extract of meat" was described early in this century.* For some time a meat extract remained a curiosity of the laboratory, and only about 1847 was its manufacture on a commercial scale initiated by Liebig; in fact, not until about 1860 was there a real extract of meat in the market. For some years "Liebig's Extract" enjoyed a monoply, but its commercial success—due, partly, to judicious advertising, as well as to its portability, keeping properties, and meaty flavour—soon brought a number of competitors on the scene; and we suffer now from a plethora of such preparations, a large proportion of which differ from each other only very slightly.

The published analyses of Liebig's Extract went to show that it was rich in nitrogen, and that it contained a considerable percentage of peptones and "meat bases." Clinically, it was found that, given with hot water, it had a powerful and rapid stimulant action, and was of the utmost value in cases where such a stimulant was required, and where alcohol would have been deleterious.

In all the subsequent preparations attempts were made to improve upon Liebig's preparation in various directions, while still preserving the main characteristics.

Looking at the tabulated results of chemical analysis of the different preparations, considerable diversity is evident with regard to some of the constitutents. The diversity, however, is

* Proust, 1801.

largely due, in many cases, to the differing percentage of water, or at least of matters volatile at 100°C; in other words depends a good deal upon whether the preparation is liquid (the so-called "Meat Juices") or pasty.

It must be clearly evident that chemical analysis alone is of very limited utility in determining the value of a meat extract, much in the same way as a chemical examination of water may be very misleading, as it takes no cognisance of the possible presence of pathogenic organisms.

Of late years an attempt has been made to increase the nutritive value of meat extracts, chiefly by extracting the meat without the aid of heat and thus obtaining a considerable proportion of uncoagulated meat albumen. On the preceding lies a very important part of the whole question of the value of meat extracts. For some time it was denied that meat extracts, as previously prepared, had any appreciable nutritive value at all, and that their sole value was as rapidly diffusible animal stimulants. It was to overcome this that the method of preparation was in some cases altered so as to preserve the nutrient constituents which had formerly been, partly at least, lost; so that now we have a number of preparations claiming to be highly nutritive as well as stimulating. Let us examine this claim a little closely. It may be admitted (see published tables of analyses) that several preparations contain a considerable proportion of albumen amongst their solid constituents, and if it could be shown, 1st, That the albumen is all derived from the meat, 2nd, That meat albumen has special advantages over, say, egg albumen, and 3rd, *That the percentage of meat bases is not diminished*, there is no doubt that the advantage would be considerable. Unfortunately for the case of the "nutritive" meat extracts the second point, as far as we know, cannot be conceded; and thus, even if the first condition is present, the whole case of the special advantages of a meat extract containing a large proportion of albumen falls, in my opinion, to the ground, as there is almost invariably a drop in the proportion of meat bases present in such extracts. It is well known that, in some of the preparations, albumen is artificially added; and although the nutritive value is there, it is a value not peculiar to meat extracts. This being in a sense a negative argument does not, so far, militate against the use of meat extracts as nutrient media, but whether this use is advisable otherwise, is another question.

As a matter of fact, in the earlier preparations the albumen was purposely got rid of by coagulation, as the result was found to be a more stimulating preparation. This is what we might *a priori* expect.

If the addition of albumen is to be held as legitimate, I see no good reason why carbohydrates and fats should not be added also, and the result brought out as another "perfect food."

In the present investigation, I have confined myself to the chemical examination of the main constituents of a selected number of meat extracts and allied preparations, and to the microscopic characteristics of the preparations.

The differentiation of the "total nitrogen" was comparatively easy up to and including syntonin, but beyond that the most careful examination yielded results differing so much as to render their value *nil* and their rejection imperative. To even partially overcome the difficulty it would have been necessary to use large quantities for analysis, and as this investigation is not intended as an exhaustive chemical analysis of the meat extracts, it did not seem advisable to carry the examination further.

Stutzer's method for differentiating the nitrogen [as described in Zeit. Anal. Chem. for 1895] is that usually employed; but the grave objection to this method is that by the use of phosphotungstic acid as a precipitant of the peptones a variable and rather large proportion of the meat bases are at the same time precipitated and reckoned as peptones. Kemmerich's method of fractional precipitation with different strengths of alcohol (Zeit. Phy. Chem. for 1894) has also been shown by König and Bomer to be unreliable in estimating peptones and meat bases. Schjerning's "halogen" method seems to be least objectionable, but sufficient data have not yet been obtained to prove that it is both constant and accurate in its results.

[Subjoined

Subjoined is a tabular statement of the results obtained by me, expressed in percentages :—

Name of preparation.	Loss on evaporation at 100°C. Calculated as Moisture.	Total Solids.	Ash.	Chlorides.	Fat.	Total Nitrogen.
Armour's Extract of Meat -	20·049	79·951	26·47	7·720	·250	8·256
Bovinine, - -	80·110	19·890	*1·399	1·050	·039	2·500
Bovril (seasoned),	42·730	57·270	18·820	8·309	2·250	7·080
Liebig Co.'s Extract,	14·855	85·145	24·920	5·860	·018	9·143
Lipton's Extract of Beef, - -	16·760	83·240	21·829	10·101	·080	8·733
Valentine's Meat Juice, - -	55·160	44·840	10·821	2·550	·050	2·850
Wyeth's Beef Juice,	63·534	36·466	13·870	6·763	·085	2·976

It may be convenient at this place to discuss shortly the points of importance with regard to the analytical methods employed.

1st, *The loss on evaporation* (at 100°C.) *calculated as moisture.*

It is evident that while, in what may be termed a *pure* meat juice or meat extract, the loss of weight may be accepted as entirely due to moisture, this does not necessarily hold good, as matters volatile at or under 100°C. are sometimes added to such preparations as preservative agents. This introduces a fallacy if the loss is put down simply as water; but the fallacy is of no great moment, as the loss is either moisture *in toto* or moisture *plus* some added volatile matter, neither of which plays any essential part in the action of meat extract from a dietetic point of view.

Of the various methods of estimating this "loss on evaporation," I unhesitatingly give first place to that performed with asbestos. The extract, made into a very thin liquid by the addition of sufficient distilled water, is distributed in a large shallow capsule of tinfoil over a quantity of recently ignited asbestos wool sufficient to more than absorb the whole, and kept at 100°C. in a water bath till the weight is constant. This gives accurate and rapid results, and is much superior in every way to simple evaporation by Stutzer's method, using sand in place of asbestos.

* This ash is rich in ferric salt.

2nd, *Total Solids.*

As fresh lean meat contains, roughly, 75 per cent. of water, it is evident that preparations losing more than this on evaporation contain less solid matter than ordinary meat, and can hardly be termed concentrated foods. On the other hand, a high percentage of "total solids" is no guarantee of high nutritive or even stimulant value; as the solids may and often do include a large relative proportion of sodium chloride.

As to the estimation of the solids nothing need be said, as the figure follows from the loss on evaporation.

3rd, *Ash.*

In the estimation of the ash great caution must be observed, else most discrepant results will be obtained. The heat must be very gentle at first so as to allow slow carbonization of the mass, thereafter increasing the heat very gradually so as to avoid partial volatilization of the chlorides. The operation should be conducted in the absence of any approach to a draught, and the ultimate weighing performed as rapidly as possible when the capsule is removed from the dessicator, as the ash is in all cases hygroscopic.

It is often difficult to get the last of the black specks (which include carbonaceous matter) converted into true ash, and the operation cannot be considered complete until the ash is of a uniform whitish-grey colour.

The small percentage of ash relative to the total solids in Bovinine is noteworthy.

4th, *Chlorides.*

The interest in the estimation of chlorides turns upon the question of added sodium chloride. A certain proportion of chlorides (mainly potassium chloride) is normally present in all such preparations, but it will be found that in most cases there are added chlorides, and as these are neither nutritive nor stimulant their presence in excess can only be regarded as an impurity, as they are added for preservative purposes merely.

Further, sodium chloride taken in large excess is a cardiac depressant, and may even be actually poisonous unless a large excess of water is also taken.

The following table shows the added chlorides (calculated as sodium chloride) present in the preparations examined:—reckoning ·06 per cent. for each 1 per cent. of "total solids." *

* Allen: Commercial Organic Analysis, Vol. IV.

Armour's Extract of Meat,	2·929 per cent.
Bovinine,	0·0 ,,
Bovril,	4·873 ,,
Liebig's Extract,	0·752 ,,
Lipton's Extract,	5·107 ,,
Valentine's Meat Juice,	0·0 ,,
Wyeth's Beef Juice,	4·575 ,,

The results shown by this table are highly interesting, but one source of possible fallacy must be pointed out. The normal percentage of chloride present in lean meat (·06 per cent. for every 1 per cent. of total solids) is calculated on the assumption that the "total solids" are entirely derived from the meat. That this is not always the case is well known; albumen and gelatine, for example, are sometimes added from extraneous sources, and thus the correlation of total solids and chlorides is interfered with. Further, reference to the table of "microscopic appearances" (pages 27 *et seq.*), shows that in some cases matters entirely foreign to meat go to swell the proportion of total solids present.

There can be no doubt that from a dietetic point of view the presence of chlorides in excess is prejudicial. It is a matter of common knowledge that salted foods are of comparatively low dietetic value. Salt in excess impairs or destroys the flavour, thus interfering with the quality of *sapidity* which plays a not unimportant part in the value of any food. Apart from its action on the flavour, an excess of common salt alters the constitution of the meat juices, and coagulates, partially at least, some of its constituents. Its addition to meat extracts is for the purpose of preservation, and (from its hygroscopic property), of assisting to keep the extract in a pasty condition.*

In the liquid preparations of meat a liquid preservative can be employed (for example, alcohol or chloroform is used in Bovinine), and there is no use otherwise for added salt. In this connection it is interesting to note that in Bovinine and Valentine's Meat Juice not only is there no added sodium chloride, but the proportion is even rather less than should be normally present, judged by the percentage of total solids.

The estimation of the chlorides was performed in the usual way, by means of $\frac{N}{10}$ $AgNO_3$ with K_2CO_4 as indicator, the ash being

* Pure sodium chloride is not hygroscopic, but common salt, containing traces of magnesium chloride as an impurity, is markedly so.

lixiviated with repeated small quantities of hot distilled water.

5th, *Fat.*

Any appreciable quantity of fat in a meat extract can only be regarded as an impurity *qua* the object intended, and we accordingly find that as a rule fat is present in extremely minute proportions, the one exception being Bovril. The percentage obtained in the case of Bovril is the average of analyses of three samples obtained from different sources.

With regard to the method of estimation, some points are worthy of notice. On the advice of Professor Glaister, and according also to the method recommended by Allen,† I employed petroleum ether. I found, however, that even with the best redistilled petroleum ether which could be obtained, it was impossible, using Soxhlet's apparatus to get the last portions of ether driven over by means of a water-bath, and I had finally to fall back on repeatedly exhausting the dry and powdered extract with petroleum ether, filtering and allowing the ether to spontaneously evaporate in a free current of air. This method gave very consistent results. On the other hand, when anhydrous sulphuric ether was employed, the results were invariably higher, and also fluctuated considerably.‡

6th, *Total Nitrogen.*

The most striking point here, is the close approximation of the percentages, the figures ranging from, roughly, seven to nine in the case of the pasty extracts, and from two and a half to three in the case of the liquid ones.

For a long time the percentage of total nitrogen was looked upon more or less as an index of the food value of the preparation. This, of course, is erroneous. As previously pointed out, any real nutritive value in such preparations must be extremely small, and is entirely subservient to their value as animal stimulants. If it were certain that no extraneous matters were added, the total nitrogen present would have a certain value as indicating a larger or smaller proportion of nitrogen-containing *meat bases*, upon which the stimulant value of meat extracts depends. But for reasons already stated, the "total solids" may not be altogether

* See Table on page 6.

† Commercial Organic Analysis, Vol. IV., p. 311.

‡ Ether dissolves to some extent other constituents present.

meat solids, so that the percentage of total nitrogen gives no absolute information as to the stimulant any more than the nutritive value of the preparation.

The nitrogen was estimated by Kjeldahl's method,* and the results differed only infinitesimally in the case of the same extract.

Differentiation of Total Nitrogen.

Various schemes have been recommended for the differentiation of the total nitrogen. After many trials of every known process, I am forced to the conclusion that beyond a certain point they are all liable to an ever-increasing experimental error as the analysis proceeds, until the results are not to be received with any degree of confidence. What is most desirable to ascertain is the proportion of nitrogen due to the meat bases present, upon which the stimulant value of these preparations depends. But there is no really satisfactory *direct* method of estimating this nitrogen, and the method by remainder is, for reasons already stated, and also owing to their varying percentage of nitrogen very unsatisfactory.† I have not, therefore, attempted to tabulate results of nitrogen differentiation, which cannot be held as scientifically accurate. The nitrogen of albumen, syntonin, albumoses, and gelatine and peptones, is of comparatively little consequence, as these contribute nothing to the stimulating properties of the preparation, while their nutritive power has little to do with the real value of meat extracts.

Two forms of nitrogen present, however, I opine to be worthy of consideration :—

1, Ammoniacal Nitrogen, and 2, Nitrogen of matter insoluble in cold water, and meat fibre. With regard to the first, it has neither stimulant nor nutritive properties, while in the second we have in the proportion due to meat fibre, what may very justly be termed an impurity in the preparation. So far then as these

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* Professor Glaister's Modification, as detailed in his laboratory notes.

† Rubner (Zeit. Biol. for 1884, p. 265), has shown that some at least of the meat bases have no nutritive value. Some of them in excess are actually poisonous. (see also "Animal Alkaloids" by Aitken). Different authorities employ different factors, *e.g.*, Hehner 6·25, Stutzer 3·12, for the estimation of the meat bases from the nitrogen supposed to be derived from them.

two forms of nitrogen are concerned, the results are as follows :—

	Ammoniacal Nitrogen.	Nitrogen of insoluble matter and meat fibre.
Armour's Extract, -	0·357 per cent.	0·248 per cent.
Bovinine, - - - -	0·021	none.
Bovril, - - - -	0·075	3·045
Liebig's Extract, - -	0·408	2·164
Lipton's Extract, - -	0·391	2·718
Valentine's Meat Juice,	0·185	none.
Wyeth's Beef Juice, -	0·244	none.

The ammoniacal nitrogen was estimated as in water analysis by diluting a few grams of the preparation with a quantity (500 c.c.) of distilled water in a distillation apparatus, adding a pinch of dry, recently ignited, sodium carbonate, distilling 100 c.c., and Nesslerizing. The process presented no difficulty.

The nitrogen of insoluble matter (including meat fibre), was estimated by diluting a few grams of the preparation with a quantity of distilled water, filtering, washing the precipitate (if any) left on the filter, and estimating the nitrogen in the precipitate by Professor Glaister's modification of Kjeldahl's method. The method was simple, but prolonged washing was necessary.

MICROSCOPIC APPEARANCES.

While at first glance it might seem that little information of any moment could be gained by the microscopic examination of meat extracts, the results appended show that this is not so, and that in some cases the information as to constituents gained by the use of the microscope revealed features which were as interesting as they were at times unexpected. The examination was conducted simply by diluting (if necessary), a minute fraction of the extract with distilled water, and examining at once on an ordinary glass slip. The appearances given are the results of a large number of experiments in each case.

ARMOUR'S EXTRACT OF MEAT.

1. Numerous large and small cubical crystals of sodium chloride.
2. Occasional leguminous starch grains.
3. Amorphous solid matter (not soluble in water).
4. Altered meat fibre showing no striation.
5. Crystals of tyrosin in clusters.
6. No corpuscular elements.

BOVININE. (UNDILUTED.)

1. An almost homogeneous yellowish medium.
2. A few altered red blood corpuscles.
3. Numerous clusters of tyrosin crystals.

BOVRIL.

1. Fairly numerous small crystals of sodium chloride.
2. Unaltered muscular fibre in considerable quantity.
3. Altered corpuscular elements.
4. Cellular vegetable tissue, the cells containing red pigment.
5. Crystals of tyrosin.
6. Fat globules.

LIEBIG'S EXTRACT.

1. Salt crystals, not very numerous.
2. Altered corpuscles.
3. Altered meat fibre in small quantity.

Medium comparatively homogeneous.

LIPTON'S EXTRACT.

1. Salt crystals, large and small.
2. Numerous red and white corpuscles.
3. Altered meat fibre without striation.
4. No tyrosin crystals.

VALENTINE'S MEAT JUICE. (UNDILUTED).

A practically homogenous yellowish menstrum, showing only a very few minute crystals of tyrosin.

WYETH'S BEEF JUICE.

1. Salt crystals, fairly numerous.
2. Leucin.
3. Tyrosin.
4. Altered corpuscular elements.
5. No meat fibre or amorphous matter.

CONCLUSIONS.

Looking at the results as a whole, it may be said at once that the claim of any of the preparations to be a concentrated food is inadmissible. It is quite clear that any proportion of real nutritive matter present is in such small relative proportion as to have little bearing on the question of the value of the preparation as an article of food, properly so called. The inherent value of meat extracts lies in the stimulant power of the meat bases present, and the best test for these is the effect on the animal economy after administration.

Undoubtedly, even as stimulants the preparations vary much in value apart from the proportion of meat bases present. The questions of ease of absorption and absence of insoluble matters are of some moment; moreover, the addition of salt as a preservtive is hurtful, as already pointed out. The liquid preparations without added salt seem best from the absence of insoluble matters and added salt.

The nutritive elements (albumen, peptone, etc.), actually present in such preparations can be supplied, and better supplied outside of meat extracts altogether; but we have no real substitute for the stimulant meat bases. On the latter, then, the true value of meat extracts depends; and while no actual objection can be taken to the presence of nutritive material in these preparations, except that there is apt to be a corresponding diminution in the proportion of meat bases (see page 20), it is evident that their value in dietetics does not depend at all on the proportion of such nutritive matter present, or in other words their real value depends on their stimulant powers as shown by clinical experience.

Attempts have been made, as already pointed out, to increase the nutritive value of meat extracts by *adding* albumen, peptone, and gelatine, to the extract proper, although in the case of gelatine any gain in real nutritive value is doubtful. Following this to a logical conclusion it would be proper, as noted on page 21, also to add fats and carbohydrates in due proportion, so that the so-called "extract" could be recommended to the public as a "perfect food."

Further, any appreciable proportion of gelatine if present *must* be in the form of an addition, as owing to the low temperature at which the modern meat extracts are prepared, the gelatine is not removed from the meat.

The proper place of a meat extract in dietetics is as a stimulant; and the stimulating action is much increased by its being administered diffused in hot water which, is itself a stimulant, so that another function of the extract may be said to be to give sapidity to the hot water which is exhibited along with it. The stimulant effect of extract of meat given in cold water would be very slight.

In the case of the liquid extracts, or so-called "meat juices," it is usually recommended that they be given in cold water; but the argument still holds good, as this recommendation is simply for the sake of appearance, as owing to the exceptional propor-

tion of albumen in these preparations the addition of water much over 180° F. causes precipitation of the albumen and forms a muddy-looking mixture.

Beef tea, made in the usual way, has several advantages over even the meat juices. The source and quality of the meat can be judged of; the flavour is much superior, and the result thus more appetising; preservatives are not required; the mineral salts and meat bases are more thoroughly extracted; and, from the higher temperature employed, much of the collagene of the meat is converted into gelatine and appears in the product.

At the same time meat extracts and juices have an extensive field in actual practice. They may be used largely and safely where rapid stimulation is required, without their giving rise to a craving for over-indulgence.

[I have to acknowledge my great indebtedness to Professor Glaister for many valuable hints during the course of this investigation].

References:—

Allen's Commercial Organic Analysis, Vol. IV.
The Analyst, Vols., VI., VII., X., XV., XVI., XX., XXI.
Journal of the Chemical Society, Vols. XXXVIII., XL., LXVI., 2; LXVIII., 2; LXX., 2.

IV.—*The Non-Elastic Deformation of Copper Wire under Various Stresses.* By JAMES S. DUNLOP, B.A.(Cantab.), M.A., B.Sc., Houldsworth Research Student at Glasgow University.

[Read before the Society, 19th December, 1900.]

FOR bodies subjected to tensile stresses, two distinct periods are generally recognised—the period of perfect elasticity, in which Hooke's law is fulfilled approximately, and the period of imperfect elasticity. The smaller the load the more nearly is Hooke's Law obeyed. For loads above a certain limit, however, there is a marked departure from fulfilment of the Law; and when the body is gradually loaded and then gradually unloaded, the strains observed during the unloading do not coincide with those observed during the loading. This is due to imperfection of elasticity. The difference between the observed strains is called *set.* The increase of set with the time for a Copper wire under various loads, was the object I had in view when I started the investigations described in this paper.

The capacity of solids to take a set which increases with the time is termed plasticity. It has been made the subject of an exhaustive investigation by M. Henri Tresca.* Assuming no change in the volume of the body, he has chiefly studied the geometrical conditions connected with plasticity. The dependence of plastic or non-elastic deformation on the time, however, is quite marked. In the tower of Glasgow University secular experiments were set on foot some years ago by Dr. J. T. Bottomley, to find out the limits, if any, to the flow in certain wires under various loads.†

The experiments I am now about to describe were carried out in Prof. Gray's Laboratory at Glasgow University. Three specimens of Commercial Copper wire—for convenience I shall call them A, B, and C—were taken from the same coil. Dr. Ander-

* Proc. of Inst. of Mech. Engineers, 1878, "The Flow of Solids."

† See Encyclopædia Britannica, article on "Elasticity," by Lord Kelvin.

son of the Chemical Laboratory at the University has kindly furnished me with the following analysis of the wire :—

Copper, 99.85 per cent. (chief impurity, arsenic).

The experiments on specimen A were intended to be of a preliminary nature, and in them the stress-strain history of the wire from its original condition up to the point at which it broke was observed. Incidental points of interest were remarked, such as the change in the Young's Modulus and density of the wire with increase in permanent set. The creeping with the time for various loads was examined in specimen B, the wire being kept constantly loaded with gradually increased loads until it broke. In specimen C, finally, the effect of changes of temperature on the plasticity of the wire was made the object of investigation.

Specimen A.

Thomson's method of double suspension was adopted in the observations for the Young's Modulus, the wire being suspended by passing it up through a carefully made hole in a brass plate, screwed to the roof of the laboratory and down through a similar hole, everything being made secure by soldering on the top of the plate. When the wire was loaded to within a few pounds of its ultimate breaking load, it gave way at the point of maximum curvature, just over the hole in the plate. Thereupon the wire was suspended by means of a small vice jacketed with lead, and the top support gave no further trouble. The load consisted of pound weights of various magnitudes, and these were placed carefully by hand in the scalepan. Prof. Ewing * and Mr. H. Tomlinson † have found this method as accurate and convenient as that of loading by running liquid into a tank. The original length of the wire was 440 cms., and when this specimen ultimately broke, it had been elongated by 24 per cent. The total load when this occurred was 48 pounds.

The following table shows the variations in the Young's Modulus, and in the specific gravity of the wire with increase of permanent set :—

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* Phil. Trans. Roy. Soc., 1885, "Experimental Researches on Magnestism."

† Phil. Trans. Roy. Soc., 1883, "The Influence of Stress and Strain on the action of Physical Forces."

State of Wire.	Permanent Set on 440 cms.	Diam.	Specific gravity.	Young's Modulus in gms. per sq. cm.
Original, ...	0 cms.	·10505 cms.	8·862	$1·172 \times 10^9$
After 40 lbs. load,	25 "	·10194 "	8·852	1·199 "
" 48 "	70 "	·09912 "	8·840	1·203 "
Final, ...	106 "	·096 "	8·808 (Mean of four.)	—

Several interesting points were remarked in the course of this investigation; but as they appear in the later specimens, a discussion of them may be deferred for the present.

Specimen B.

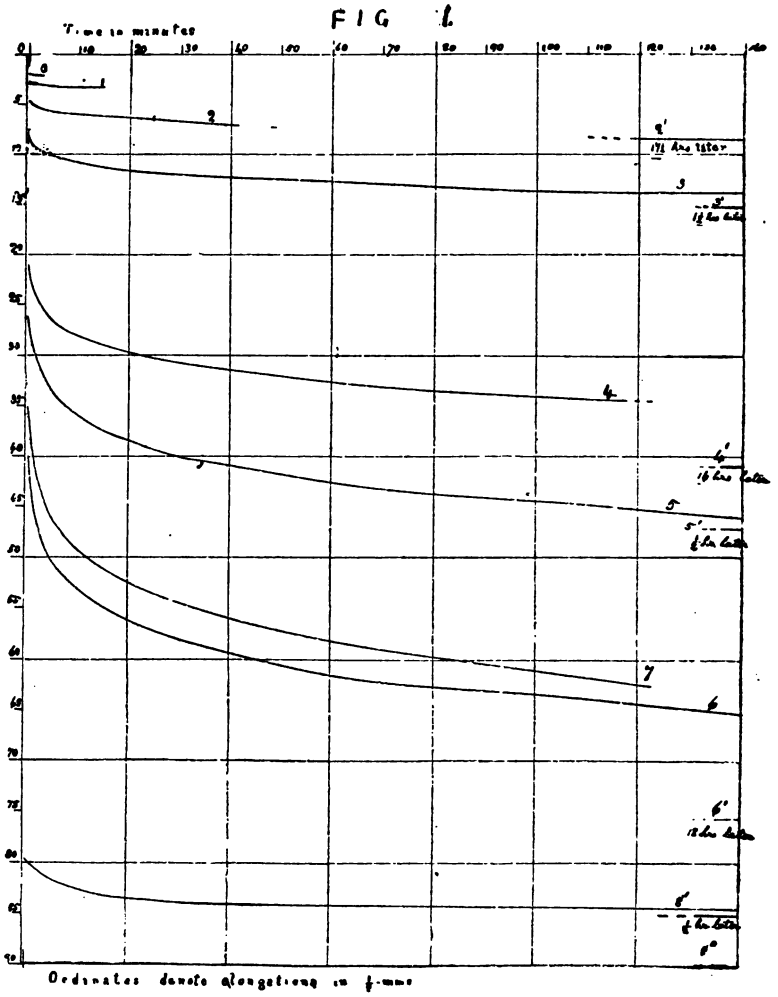
This wire was suspended in a manner similar to the previous one. After the elastic limit had been passed, the additional loads were added, two pounds (latterly one pound) at a time. The sets acquired, and the times occupied in so doing, for the various stages in the loading, are shown in the following table:—

Total Load.	Total Set on 440 cms.	Set at each Load.	Time.	Specific gravity.
S+14 lbs.	1 cm.	1 cm.	19 hrs.	8·862
" 16 "	2 "	1 "	4 "	
" 18 "	4 "	2 "	19 "	
" 20 "	6·5 "	2·5 "	3 "	
" 22 "	10·7 "	4·2 "	21 "	
" 24 "	13·5 "	2·8 "	2 "	
" 26 "	22·5 "	9·0 " (abnormal)	3 "	
" 28 "	24·6 "	2·1 "	21 "	
" 30 "	27·7 "	3·1 "	70 "	
" 32 "	32·7 "	5·0 "	2 "	
" 34 "	40·8 "	8·1 "	20 "	
" 36 "	52.9 "	12·1 "	23 "	
" 37 "	60·2 "	7·3 "	28 "	
" 38 "	73·7 "	13·5 "	22 "	
" 39 "	95·5 "	21·8 "	81 "	(Mean of six pieces)
" 40 "	117·8 "	22·3 "	1½ "	8·807

S denotes scalepan, which weighed about 8 lbs.

At the various stages in the loading, a first reading of the scale giving the elongations was taken 30 seconds after the level load was increased. Thereafter readings were taken at intervals of one minute, until the creeping became comparatively slow, when larger intervals of time were allowed to intervene between successive observations.

Fig. 1. Fig. 1 shows graphically the creeping observed during the initial stages.



Curve 0 shows 18 lbs. creeping.

"	1	"	20	"	"			
"	2	"	22	"	"	2′	being	17½ hours later.
"	3	"	24	"	"	3′	"	1½ "
"	4	"	26	"	"	4′	"	16 "
"	5	"	28	"	"	5′	"	½ "
"	6	"	30	"	"	6′	"	18 "
"	7	"	32	"	"			
"	8′	"	34	"	"			(abnormal).

It is interesting to remark the progressive nature of the curves of creeping; they seem to indicate that as the loads increased in arithmetical progression, the magnitudes of the resulting creeps increased in geometrical progression. The slight departure from this relation afforded by the diagram is due to the hardening effect of long continued stress, a phenomenon repeatedly noticed throughout the course of the present investigations.

Curve 8′ is exceptional, the dash indicating that during the first 30 secs. of the 34 lbs. load the wire crept a length of the diagram, together with the 80 additional half-millimetres as indicated in the diagram. This abnormal initial creeping was followed by an exceptionally slow creeping. The stress-strain diagram drawn from the results in the previous table, would exhibit a point of inflexion near the 34 lbs. point. Phenomena of a somewhat similar nature were observed by Dr. Bottomley* and by Prof. Ewing,† in specimens of soft iron wires. These may have some connection with what is known as the Yield-point. Prof. Ewing, however, remarked that specimens cut from the same bundle, but annealed, did not exhibit the peculiarity in question. It is therefore possible that the large creeping is connected with the internal strains produced in the wire during the process of drawing out; for the effect of annealing is to put the wire into what is termed a state of ease, thereby removing all the internal strains.

Fig. 2. Fig. 2 shows the results of the immediately succeeding observations.

Curve	9	shows the	35	lbs.	creeping.
"	10	"	$35\frac{1}{2}$	"	"
"	11	"	$35\frac{3}{4}$	"	"
"	12	"	36	"	"
"	14	"	38	"	"
"	15	"	$38\frac{1}{2}$	"	"
"	16	"	$38\frac{3}{4}$	"	"

The sinuous nature of these curves (9 and 12 in particular) is most interesting. In specimen A a similar irregularity was remarked at a slightly earlier stage in the loading. It may be due

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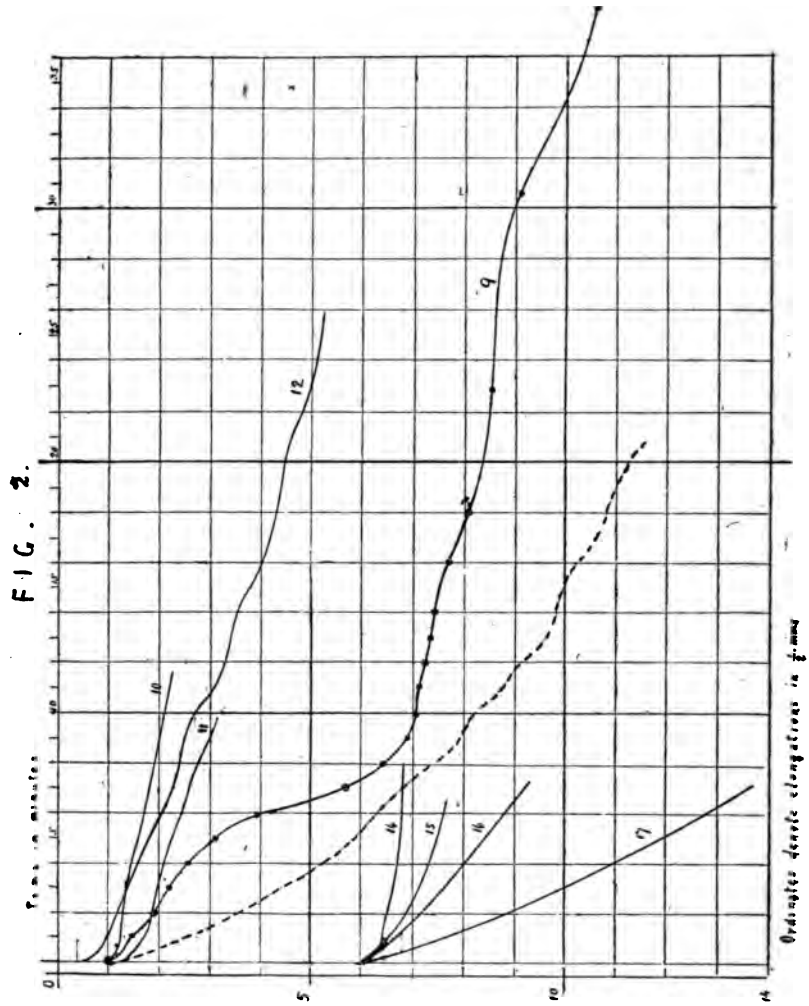
* Proc. Roy. Soc., 1879, Dr. Bottomley "On Preliminary Experiments on the effect of long continued Stress on the Elasticity of Metals."

† Proc. Roy. Soc., 1880, Prof. Ewing "On certain effects of Stress on Soft Iron Wires."

to a breaking up of stable molecular groups, and a reformation of other stable ones. The development of this phenomenon at the same stage as that just described, namely, the abnormal initial



creeping with the 34 lbs. load on the wire, should be noted, as it seems to indicate a close connection between the two. Mr. H. Tomlinson * remarked an analogous variation in the increase of

* Trans Roy. Soc., 1883, "The influence of Stress and Strain on the action of Physical Forces."

the resistance to an electric current of a loaded copper wire. The following passage occurs in his paper:—"A piece of copper wire having been loaded for some time with six measures of water, was still further loaded with one measure, this being allowed to enter very slowly into the pail attached to the wire; the current from a Daniell's element was kept flowing through the 'bridge circuit,' and the alteration of resistance observed by noting the position of light on the scale. From this last experiment we learn that, though the wire had been so carefully loaded, and the room free from vibrations of any sort, the increase of resistance did not, shortly after loading, take place smoothly; but the difference of increase of resistance or consecutive minutes became alternately greater and less." The dotted curve in the diagram has been plotted from Mr. Tomlinson's results. The variation in the resistance was exceedingly slight, one scale division indicating an amount equal to one ten-millionth only of the whole resistance; while forty-five divisions measured the increase of resistance during the first minute. The close resemblance between this curve and curves 9 and 12 is very striking.

Fig. 3. Fig. 3 shows the curves of creeping during the final stages in the loading of specimen B. The scale is smaller than in Fig. 1, having been reduced in the ratio of four to one.

Curve	22	represents the	44	lbs.	creeping.
"	23	"	45	"	"
"	24	"	46	"	"
"	25	"	47	"	"
"	26	"	48	"	"

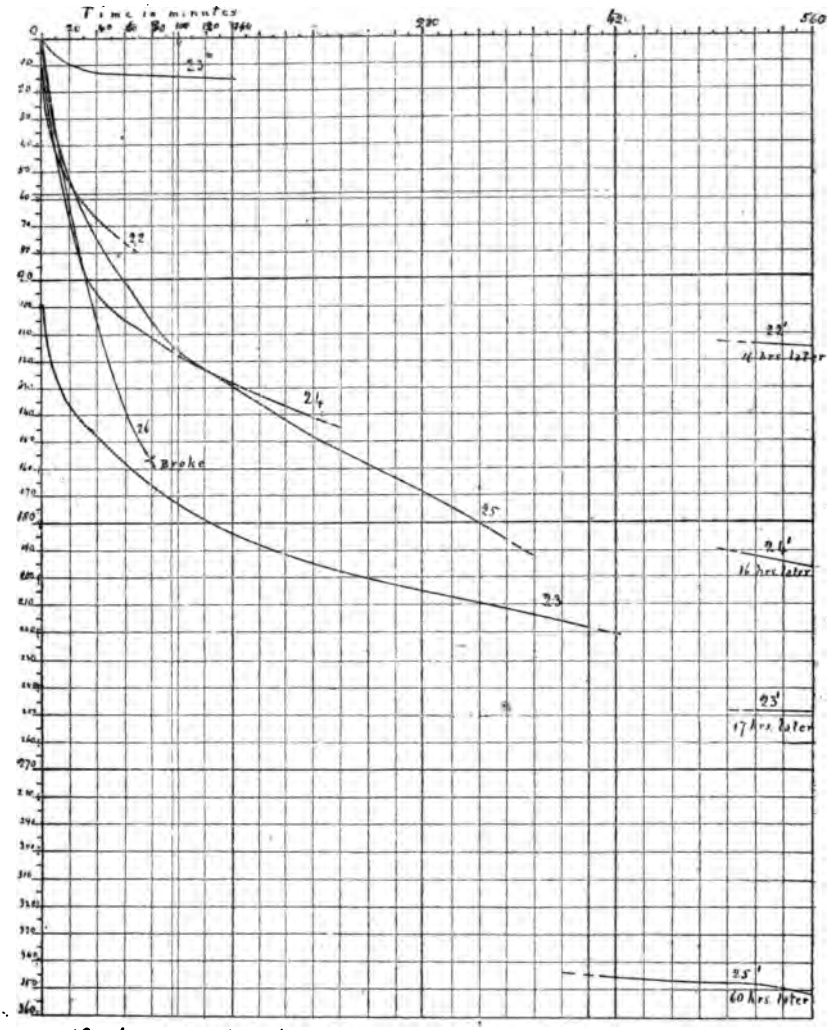
After the 45 lbs. creeping had been allowed to exhaust itself in great part over night, as indicated by curve 23′, the weights were removed from the scalepan for the first and only time during this investigation, and then carefully replaced after the space of five minutes. The further creeping indicated by 23″ ensued. The semi-plastic condition of the material immediately after overstrain thereby indicated, was noticed for iron by Bauschinger,* and also by Prof. Ewing.† In this connection, also, reference might be made

* "Ueber die Veränderung der Elasticitätsgrenze," "Civilingenieur," 1881.

† Proc. Roy. Soc., 1895, Prof. Ewing "On Measurements of Small Strains in the Testing of Materials and Structures."

to Mr. J. Muir's paper on "The Recovery of Iron from Over-strain." *

FIG. 3.



Ordinates denote elongations in $\frac{1}{2}$-mms.

A further point of interest is brought out by curve 25', which deserves more than a passing notice as it leads up to the investiga-

* Trans. of Roy. Soc., Vol. 193.

tions conducted on specimen C. After the 47 lbs. load had been on the wire from a Friday to a Monday, careful observations of any further creeping were made from 9 in the morning to 12.30 p.m. The temperature rose slightly at noon, and the curve indicates a corresponding increase in the flow. "The Effects of Changes of Temperature on the Elasticities and Internal Viscosity of Metal Wires,"* as observed by Prof. Gray, Mr. V. J. Blyth, and myself, should be referred to in connection with the investigation now to be described.

Specimen C.

This wire was suspended, and the readings of temperature effected, in a manner similar to that described in the paper just referred to. Before the observations on the creeping of the wire were commenced, a solid cylindrical vibrator weighing 18·7 lbs. was firmly clamped to the bottom of the wire, and preliminary observations were made on the effect of changes of temperature on the torsional set produced by a certain twist applied to the vibrator. A horizontal half-millimetre scale was gummed to the foot of the vibrator, the radius of which was 6·35 cms., and two telescopes with axes at right angles to each other were focussed on the scale. Vertical spider threads in the eyepieces enabled the rotations to be measured. The vibrator was then carefully twisted through 200 scale divisions, or 90°24′, and maintained there for 30 secs. It was then brought slowly back, and the resulting permanent twist was observed by the telescopes, the mean of the two being taken. No backward creeping could be remarked in the course of an hour. The initial set at a low temperature (about 15°c.) due to a rotation of 30 seconds duration through 90° was 1·725 scale divisions. This was repeated again and again, until the wire ceased to take any appreciable additional set for successive twists. The whole operation was repeated with steam running through the jacket, when the temperature of the wire might be something like 95°c. This time the initial set was 4·85 scale divisions, or approximately two and a half times as great as that at the low temperature. Before this rotational creeping had exhausted itself, the wire was cooled down by running cold water through the jacket, and the observations were repeated. It is interesting to remark that a renewed creeping at the low temperature ensued,

* Proc. of Roy. Soc., Vol. 67.

and that, on repeating the creeping at the high temperature, the ratio of the first 30 seconds' creeping at the high to that at the low temperature was again found to be about 2·5.

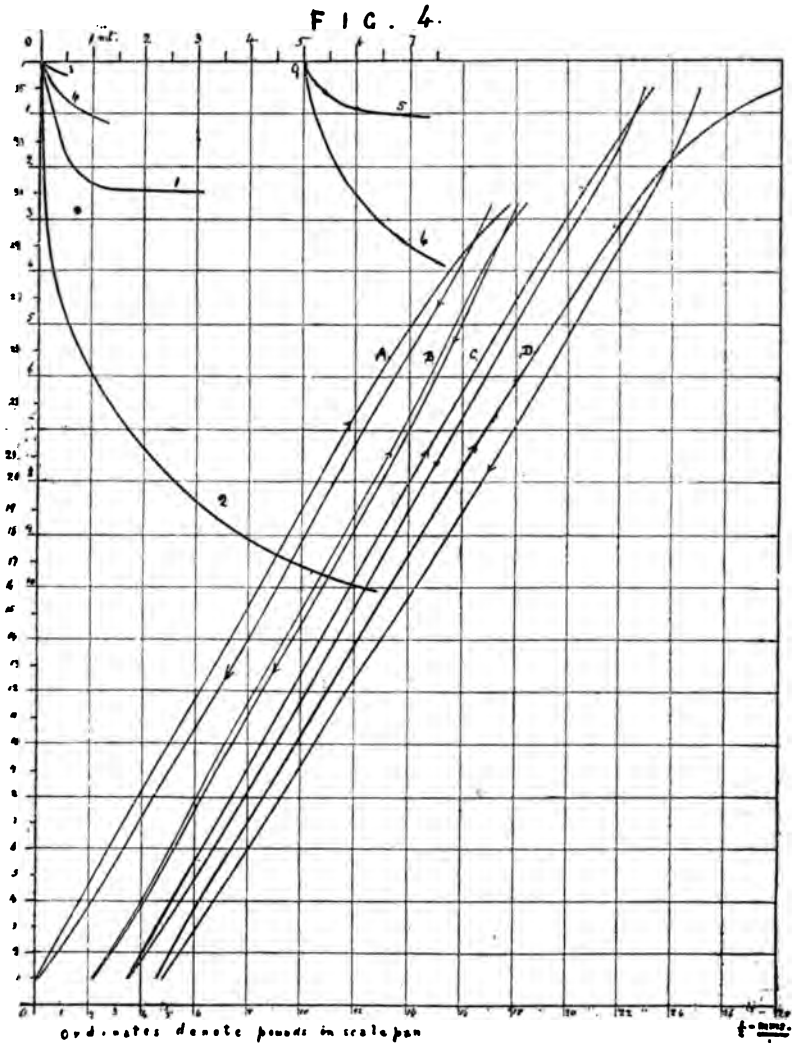


Fig. 4. Curves 1, 2, 3 and 4 of Fig. 4 show these effects, the order being that in which they were described. The origin of co-ordinates is situated at the top left hand corner of the diagram, the time in minutes and the rotational set in scale

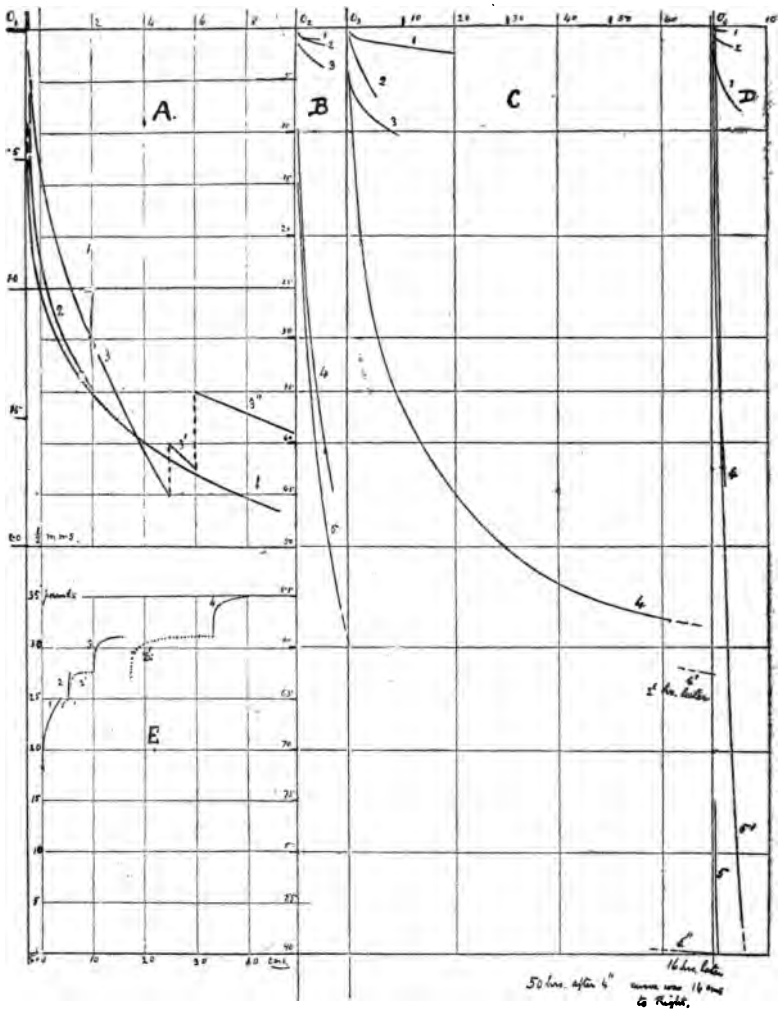
divisions being represented by the abscissae and ordinates (measured downwards) respectively. Curves 5 and 6 may be noticed here. They indicate the results obtained on repeating these observations at the close of the investigation of specimen C, after the wire had been considerably elongated by downward creeping at both the high and the low temperatures. The same ratio between the initial sets again revealed itself. These curves should not be compared directly with curves 1 and 2, as showing the effect of longitudinal set on torsional set; for they indicate only additional sets after those represented by 1 to 4 had been already acquired. The time elapsing between the two sets of observations was one month exactly.

After these preliminary observations had been made the vibrator was removed, and a scalepan weighing 4 lbs. put in its place. This was loaded as in specimens A and B, and the creeping at the various stages was observed, steam being run through the jacket at times to remark the effects of changes of temperature.

Fig. 5. A clearer view of the methods followed may be obtained from diagram E of Fig. 5. This gives the stress-strain history of the wire as far as the observations have hitherto been carried. The ordinates denote the load in pounds in the scalepan, and the abscissae the elongations in centimetres. Dotted lines refer to observations made at the high temperature, continuous lines to those at the low. Thus, when the wire had been loaded gradually at the low temperature up to a total load of 29 lbs., 4 lbs. were removed and the steam turned on. Careful reloading revealed quite a marked creeping at a load of 28 lbs. This is indicated by curve 1′ of diagram E. After exhausting the 29 lbs. creeping in great part, however, with steam in the jacket, the wire was cooled down, and additional weights were added. At a load of 30 lbs. no creeping could be remarked in five minutes, and on leaving the load of 31 lbs. to exhaust itself overnight, a total elongation of 2 mms. only could be detected next morning. This part of the operation is indicated by curve 2. The dotted curve 2′ indicates that, when part of the load had been removed and steam passed through the jacket, a careful reloading caused the wire to flow before the 31 lbs. load had been reached. Curves 3 and 3′ show this effect on a larger scale for a load of 35 lbs. The horizontal parts of these indicate a retention of the load on the wire for a considerable time. The curves of creeping then

remarked at the low and the high temperatures have been plotted in Fig. 6; but a discussion of them is reserved for the present.

FIG 5.



Of the other diagrams in Fig. 5, A is on a scale ten times as large as B, C, and D, and brings out a rather interesting point. After the 35 lbs. had time to exhaust the creeping at the low temperature by being left on the wire from a Friday to a Monday,

all the weights were removed from the scalepan. On being carefully reloaded it showed a further creeping represented by curve 1, the total load being 35 lbs. A half-pound and a quarter-pound were then successively added to the load and removed in the reverse order, the whole operation lasting 10 mts. Curves 2, 3, 3′, and 3″ show the creepings observed at the various stages. A remarkable additive property possessed by the curves of creeping is hereby indicated: 3′ seems to be a continuation of 2, and 3″ a continuation of 1, if account be taken of the time intervening between the several observations.

Diagram B of Fig. 5 shows the creeping on loading at the high temperature after the creeping at the low temperature with a load of 35 lbs. had been exhausted.

Curve	1	denotes creeping at	31	lbs.
"	2	"	32	"
"	3	"	33	"
"	4	"	34	"
"	5	"	34½	"

It is of interest to note that curve 5 is an exact repetition of curve 2 plotted with its scale of elongations ten times as large.

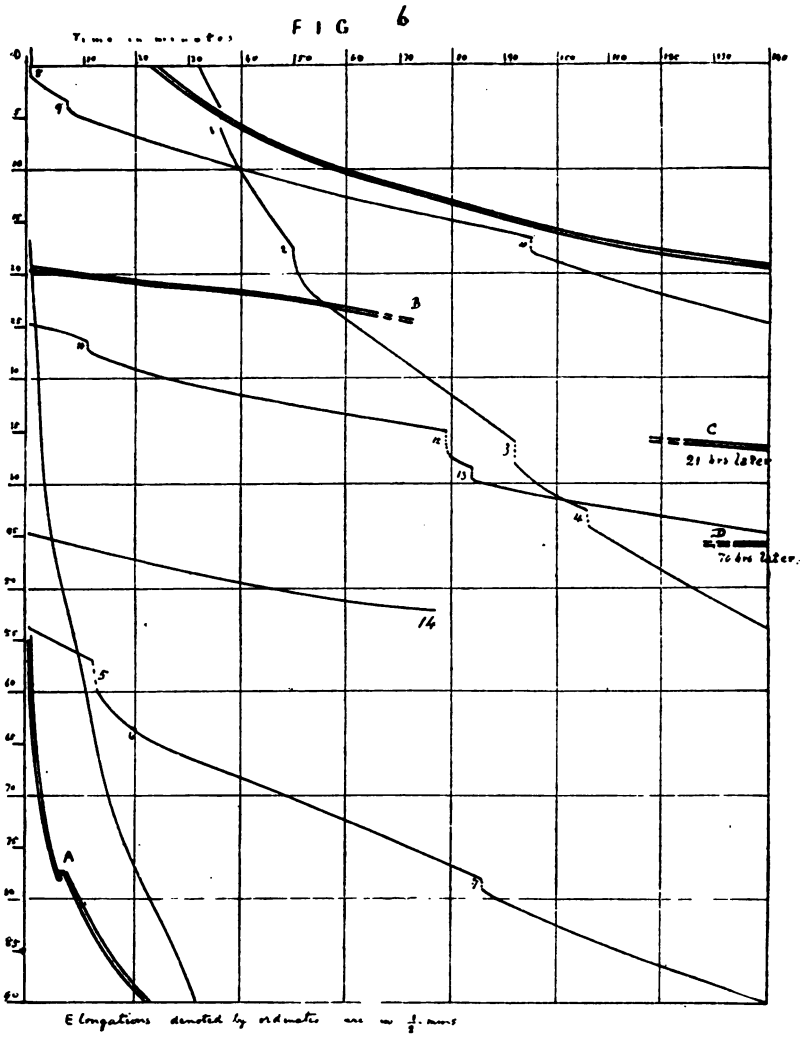
Little need be said about the curves shown in diagrams C and D of Fig. 5 more than to indicate at what stages in the wire's history they were observed, and to specify for each of them the total loads. Diagram C represents a careful loading at the low temperature after the 35 lbs. creeping with steam passing through the jacket had been going on for more than 10 hours. A very slight creeping could be remarked with a load of 36 lbs. on the wire.

Curve	1	represents creeping at	37	lbs.
"	2	"	38	"
"	3	"	38½	"
"	4	"	39	"

Diagram D shows the creeping at the high temperature after the 39 lbs. creeping at the low temperature had time to exhaust itself from a Friday to a Monday.

Curve	1	represents creeping at	35	lbs.
"	2	"	36	"
"	3	"	37	"
"	4	"	38	"
"	5	"	39	"

Fig. 6. Fig. 6 shows the creeping with the 35 lbs. load already referred to. The creeping at the high temperature represented by the single line is the additional creep-



ing observed after the 35 lbs. creeping at the low temperature had been allowed to exhaust itself completely, as indicated by the double line A B C D. At A one pound was removed but was immediately replaced when no sensible creeping could be remarked

at the reduced load. The breaks in the curve of creeping at the high temperature for the most part indicate that the steam was shut off to enable the boiler to be refilled. During this process part of the load was removed to be replaced after the steam was again passing through the jacket. The temporary increase in the creeping observed immediately afterwards is interesting. At the points 2, 5, 8 and 12 Elastic Hystereses were observed, in some cases at both the high and the low temperatures. After 14 further creeping at the high temperature with the 35 lbs. load was discontinued. The outstanding point of interest revealed by this diagram is that, while the creeping at the low temperature is represented by 136 scale divisions, the further creeping at the high temperature is represented by 329 divisions. The ratio between these two numbers is 2·4. In the light of the preliminary observations on the effect of temperature on torsional set, this ratio is interesting. The development of the sinuosity at the high temperature under a load of 36 lbs. is noteworthy.

In Fig. 4 curves showing the Elastic Hysteresis observed at the low and the high temperatures have been plotted. Prof. Ewing, who first pointed out the Hysteresis effect in relation to the magnetisation and demagnetisation of a piece of Soft Iron, pointed out the same effect in the relation of strain to stress in solids that have been strained beyond their elastic limits.* The curves are referred to the bottom left hand corner of the diagram as origin, the ordinates denoting the load in the scalepan in pounds and the abscissae the corresponding elongation in half-millimetres. A shows the Hysteresis observed on unloading and reloading, just after the creeping with a load of 35 lbs. at the high temperature had been completed. The whole operation lasted 10 minutes, and during one minute at which the wire was kept with a load of one pound in the scalepan (or a total load of 5 lbs.) a backward creeping of 0·1 of a scale division was remarked. B is the corresponding Hysteresis for the low temperature. It was taken the next morning, every detail in the operation being an exact repetition of that at the high temperature. This time the backward creeping observed was 0·05 of a scale division. The greatest breadth of A was 0·75 divisions, that of B being only 0·3. In the light of the previous observations on specimen C, the ratio between these two numbers is noteworthy. C and D represent

* B. A. Report 1889, p. 502, "Hysteresis in the relation of Strain to Stress."

Hystereses observed at the low and the high temperatures respectively while a marked creeping was taking place. The creeping continued during the initial stages of the unloading and complicated the resulting curves. In connection with these curves Mr. J. Muir's paper* might be referred to.

As illustrating a practical bearing of the investigations just described, the following point may be noted:—An indiarubber tubing connection between the boiler and the sourcepipe of the jacket was bound with a piece of the copper wire under investigation. This was done at the low temperature. When steam was passed through the pipe, besides the expansion due to the rise of temperature, an additional set was given to the wire in its altered state, thereby rendering the copper binding slack. The binding should have been put on at the high temperature and no subsequent heatings would have caused an additional flow. The wire would thus have remained as taut as it was originally made, and no subsequent escape of steam could develop.

A detailed description of the investigations on three specimens of commercial copper having thus been given, it is natural to put the question:—What light, if any, do these observations throw on the ultimate constitution of matter? It may be that a definite answer to this question cannot be given, so many and varied are the methods by which physicists and chemists have attempted to unravel the mystery surrounding the constitution of matter. M. Henri Tresca,† in his paper already referred to writes:—"The idea of the flow of solids is, of all the modes of regarding their deformation, the one which gives us the surest information on all phenomena of molecular mechanics as well as on the internal structure of the substance upon which the various industrial operations are performed." Sir William Roberts-Austen,‡ again, after describing a very delicate pyrometer by which the internal cooling of metals and other bodies could be studied, writes:—"It opened up a way to get at some definite knowledge regarding the constitution of matter and its molecular aggregations." His name further suggests the microscopic examination of the structure of metals, in which connection reference should be made to "Experiments in Micro-metallurgy: Effects of Strain,"

* Trans. Roy. Soc., Vol. 193, "The Recovery of Iron from Overstrain."

† Proc. Inst. Mech. Engineers, 1867, "Flow of Solids."

‡ Proc. Inst. Mech. Engineers, 1893, "Alloys research."

recently carried out by Prof. Ewing and Mr. W. Rosenhain.* The authors point out that the appearance of "slip bands" on the faces of the crystalline grains of the metal after the metal has been stretched beyond its elastic limit, indicates that plasticity is due to slip on the part of crystals along cleavage or gliding surfaces. "A beautiful development of slip bands," they write, "may readily be produced by pinching a button of polished copper in a vice." In this way they account for the phenomena connected with flow or non-elastic deformation in metals.

In wires the crystalline grains in the metal are drawn out by the processes of cold-rolling or wire-drawing into fibrous strings. With a modification, therefore, adapted to this fibrous nature it may be that the non-elastic deformation of copper wire can be considered as due in great part to the occurrence of these slippings. Prof. J. O. Arnolds, in the Alloys research just referred to, laid it down as an axiom in steel metallurgy, that if care were taken of the crystals the molecules would take care of themselves.

All the phenomena, however, it may finally be remarked, observed in the investigations described in this paper, may be considered as illustrating Maxwell's views on the "Constitution of Bodies."† This has been slightly touched upon in considering the breaking up of stable groupings of the molecules. There is a further very remarkable analogy between the observed phenomena and those noticed by Prof. Ewing in his "Researches on Magnetism,"‡ which cannot fail to be exceedingly suggestive. Indeed, Clerk Maxwell (in his Electricity ii. Part 3, chap. vi.), following up the analogy to a strained solid whose elasticity is perfect up to a certain limit, suggests a modification of Weber's theory of magnetisation, so as to take account of retentiveness. This he ascribes to something resembling the permanent set or non-elastic deformation of an overstrained solid. To illustrate this analogy a model may be constructed giving results very closely resembling those observed in the magnetisation and demagnetisation of iron, and an attempt made to illustrate by its aid the phenomena connected with the subject of this paper. It must be remembered, however, that such a model cannot fail to be but a crude representation of molecular movement.

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* Proc. Roy. Soc., 1899.

† "Encyclopædia Britannica."

‡ Trans. Roy. Soc., 1885, "Experimental Researches on Magnetism."

V.—*The Chinese People and their Religions.* By Dr. JOHN ROSS of Manchuria.

[Read before the Society, 27th February, 1901.]

CHINA has recently risen, a portent of evil, on the horizon of Western politics, and it will never again set out of sight Recent events have brought China into close quarters with Europe, and nothing can make her return to her former isolation. For weal or for woe, or for a combination of both, we have to lay our permanent account with China as a dominating element in our national life. China is not a "sick" man. The vitality and the energy of the race can compare favourably with those of any European nation. Hitherto China has been playing at Blindman's-Buff in the face of Europe. The handkerchief has been torn off her eyes, and a few years hence we shall discover a difference.

The Chinese people occupy the whole of the mainland of the East of Asia, from Annam on the South, to Siberia on the North. Their climate varies from the northern portion of the Tropics, through all the Temperate, into the south of the Frigid Zone. These people toil without risk all day long under the tropical sun. They can make themselves comfortable in the frosts of the far north, where the hardy Russian can barely subsist. Under the Equator the Chinaman will convert rubbish heaps into beautiful and richly productive vegetable gardens. In Central Asia he can make a happy home on lands which the Russian peasant abandons as unworthy of cultivation. In the reclamation of land, the utilisation of canals, the erection of beautiful bridges, the building of huge walls, the Chinaman has many centuries ago attained by his empirical common sense, to what Europe has in modern times acquired by science. His industry, perseverance and shrewdness, are excelled by no nation. His native-born intellect is of a high order, and requires only the thorough knowledge and application of mathematics and logic, and the accurate training of science, to enable him to take his stand alongside the most favoured nations of the west.

The Chinese government will at present agree to the needlessly humiliating terms of peace "made in Germany." These terms of peace will lie athwart her path like a heap of logs in the bed of a mountain stream. For a time the waters will be dammed up, and then the flood will seize the logs, and with a roar and a crash, will fling them out of sight. No chain which the West can forge will bind China a prisoner for any length of time. The more lawless and outrageous the European armies act now in the field, the more certain and the more speedy will come the overthrow of the influence and the prestige of the west.

The Turk invaded Europe from Asia with the sword. That sword is now so blunted that it cannot again be used to terrorise Europe. China goes everywhere, with the spade, and the more it is used the sharper and brighter does it become.

Anything, therefore, which throws any light on this peculiar people, must be more than interesting at the present juncture. One line of instructive enquiry would be an examination into the causes of the long continued and anomalous existence of this one alone of all Great Powers of the ancient world. But at present I confine myself to some brief remarks on a few of the outstanding physical and ethnical characteristics of the people, with some notes on their religious systems, as an indication of their mental condition.

Dr. Edkins, who has devoted more time and study to Chinese history than any living man, has announced to the world his belief that the Chinese went East from Babylon. Unquestionably the Chinese did migrate from the west, and found their way into China along the course of the Yellow river. The shadowy finger of remote history points to the Chinese on the banks of the Yellow River, directly south of the present Peking, which was at that time occupied as a grazing ground by the barbarous ancestors of the nomadic Mongols. The province which formed the original Chinese kingdom is called Shensi, whose capital is Singan-fu, to which city the Chinese court fled, and where it still resides. The first reputed king of that kingdom was Fu Hi. He is said to have taught the Chinese the use of clothing, and to have introduced the decencies and amenities of social life. His period was about 22 centuries B.C.

Amid some things which may be true about this man, and much that is mythical, one fact is certain. From the earliest ages the Chinese have been diligent observers of the phenomena of

nature, and particularly accurate in describing any extraordinary occurrence in the heavens. A certain eclipse is described in the most ancient history of China as occurring in the time of Fu Hi. By the early learned Jesuit Fathers this eclipse was calculated to have taken place in the year 2155 B.C. That date goes back 4000 years, a space of time which takes us to within a few centuries of the date usually ascribed to the Deluge. For fully 3,000 years we have the authentic history of China in a continuous succession of the leading events connected with that country.

From the earliest ages the Chinese have been diligent cultivators of the soil. The Yellow River, which on account of its annual floods has acquired the name of the Sorrow of China, rises in the high mountains of Central Asia. In the impetuous mass of its swift flowing waters, it carries in suspension a large proportion of yellow earth—loess, as it is called. Hence comes the name of the river. Almost annually its floods spread over hundreds of square miles, leaving on the surface of the land, as the Nile does in Egypt, a thick coating of mud, composed of the sediment borne in its waters This has made the land on both banks of the river particularly rich and fertile. On these lands the Chinese people grew and multiplied.

The small, well cultivated kingdom was surrounded by unknown wilds and illimitable forests. These were inhabited by a race, or races, chiefly nomadic, which occupied the land before the appearance of the Chinese. The Aborigines were inferior to the Chinese in diligence, in perseverance, in intellect, and in the comforts of life. For 3,000 years the Chinese had to protect with the sword what they had secured by the labours of the plough and the sickle. The barbarians around them preferred to pilfer from the granary rather than raise the grain by their own labour in the rich and limitless land at their disposal. Though, therefore, the Chinese have ever been a peace-loving people, they have never had long rest from a more or less serious war, to preserve the fruit of their toil. They were therefore as ready to fire their arrow, and as deft to wield their sword, as they were in guiding the slow ox in their unvarying old plough, which resembles that of ancient Rome. The ceaseless labour expended in converting the wilderness into a flourishing garden, wherein they erected homes and planted villages, produced in them an intense attachment to the soil—an attachment which has continued to this day the deepest passion of the Chinese heart. For their home and

community they would therefore fight with a tenacity of purpose, which a nomadic people with no fixed abode, could not understand. Hence the Aborigines were gradually pushed backwards in all directions, many of them meantime becoming amalgamated with the ever growing Chinese people. Thus grew the Chinese nation little by little, in numbers, in extent of country, in literature, in manners, and in intelligence. Steadily, slowly, and surely, like the resistless sweep of the rising tide, the people spread out in all directions, not so much by means of the sword, as by the spade and the plough. They occupied acre after acre, and added mile to mile, till, after many centuries, their busy crowds cultivated all the rich valleys between the Yellow River and the Yangtze.

Yet, as late in their history as the time of Confucius, the Chinese, who were then broken up into separate kingdoms, resembling the Heptarchy of England, were surrounded, east, west, north, and south, by Barbarians, who were divided into nine different classes. The Chinese occupied the centre of the country —hence their name of "The Middle Kingdom." The barbarians around them they figuratively denominated "The Four Seas." The great country south of the Yangtze was never occupied by the pure Chinese race. It was annexed to the empire of China about the introduction of the Christian era.

The rising tide still presses forward in the same quiet, insistent, irresistible fashion. In the north-east the Chinese are ever advancing, till now they are a strong force of industry in Southern Siberia, and in the maritime province of Russia, being in large numbers in Vladivostock and its neighbourhood. Northwards, they press into Mongolia, where they convert the Mongol pasturage into fertile fields, which yield abundance for hundreds, where the Mongols had a difficulty in feeding units. Westwards, through Central Asia, the same industry has brought them to the eastern confines of Russian Turkestan, and to the north of the States bordering on India. Southwards, they are pouring in a continuous stream into Burma and Annam. The Malay Peninsula will soon have more Chinese than Malays. Into the busy and flourishing port of Singapore nearly 200,000 Chinese found their way by steamer last year. There they carry on almost all the industry, and most of the merchandise of that great port. Along the tropical route of the numerous steamship companies from China to India, the Chinese abound, as they are the most reliable source of labour. A considerable colony has settled down in

Calcutta, and even in London there is the permanent Chinese quarter. Their keen eagerness for better conditions of life, their untiring industry, their gentle and suave manner, their orderly and peace-loving disposition, enable the Chinese to penetrate through all barriers, as the soft tongue of some bivalve molluscs pierce slowly through the hardest stone. The yellow race may meantime be defeated on the field of battle, they will never be conquered in the sphere of industry.

The Race.

When first I went to China, it was across the American continent, by the newly opened trans-continental railway to San Francisco. On the western frontier of American civilisation the train was suddenly pulled up. A waterspout had descended on the mountain west of us in the early morning, and had torn down the mountain side. Earth, rocks and trees, were washed down on the railway line for several miles in length, and to the depth of several feet. Chinese labourers were summoned from San Francisco to clear away the *debris*. Anxious to see the people to whom I was going as a missionary, I walked along the buried track. Swarms of boys from fourteen to seventeen years of age were scattered over the track with picks and shovels, working like so many ants. Coming across a big robust Irish ganger, in course of conversation I asked him, "But where are the Chinese MEN?" With disdain he pointed to the busy throng of boys and said gruffly, "That's all we've got for men!" Then it appeared to me for the first time, that the Chinese were a puny and insignificant race. This was afterwards discovered to be a mistaken impression, which is not an uncommon one, as most of the Chinese who find their way to the west, in a menial capacity, are natives of the regions south of the Yangtze. In the Chinese Embassy in London, you will see a different kind of man—the northern Chinaman, tall, graceful, well formed, and of excellent physique. These are specimens of the real Chinese race.

It will have been noted that in the preceding part of this paper there was a sharp distinction drawn between the pure Chinese and the Aborigines, who previously occupied the lands of China. The pure Chinese race, which occupies northern China, is a race as tall, as well developed, as muscular, as physically powerful as any race in the world. In the southern half of China, among the

numerous mountain ranges there are many communities, or clans of independent or semi-independent people, who are in all respects different from the Chinese. The farther south one goes, the more common are those independent communities. They are particularly numerous among the natives on both sides of the Yangtze. Many independent tribes, apparently of the same race, occupy the mountain ranges along the west and south-west borders of China. These people are known by the names of Man, Miao, Yao, and others. These are the representatives of the Aborigines of China, who were driven by the ever encroaching Chinese into the difficult mountain fastnesses, as the Welsh and Highlanders were compelled to retreat into the mountains of Britain, before the encroaching Anglo-Saxon race. The present so-called Chinese who inhabit the regions south of the Yangtze, are of the same aboriginal stock. So, apparently, are the Burmese, the Annamese, the Malays, and probably the Japanese. Physically they are in all respects inferior to the Chinese, nor can they anywhere compare with them in industry and intelligence.

About the beginning of the Christian era the large kingdom which existed south of the Yangtze, became part of the Chinese Empire. Soon thereafter the fame of Confucius, which had been gradually growing, began to be sounded in these newly acquired territories. The ethics and politics embedded in the classics of Confucianism did for China what no force of arms could have accomplished. Confucianism did there, what no ethical or religious system has done for any other race of mankind. It has made the pure Chinese race of the north, homogeneous with the non-Chinese race of the south. To this day the speech of the north differs *in toto* from the dialects of the south. But in the written language there is not a particle of difference. The literature is one. The spirit of the teaching of literature is everywhere the inspiring ruler and formative influence among those originally different peoples. The mental assimilation has become so complete, that the Chinese are now able to detect no racial distinction between one part of the Empire and another. Yet to the intelligent observer the distintion is obvious.

All the changes of dynasty in China have been effected by men of the north. All the famous generals have been from the North. Almost all the great philosophers whose names are everywhere held in reverence, were born not far from the banks of the Yellow River. The might and the thought of the Empire are concen-

trated in the north. The active, living heart, and ruling intellect of China, are almost conterminous with the scenes of massacre and misrule which have lately startled the world.

But the deft fingers belong to the south. They produce the works of skill in ivory, silver ware, porcelain, and silks, which have long roused the wonder and admiration of Europe.

There certainly has been going on a slow commixture of the peoples. This has produced isolated and local changes. But the general and outstanding characteristics of north and south remain practically the same. The northern Mandarin tongue is slowly gaining ground, and will doubtless ultimately become the one spoken language. Meantime the linguistic characteristics continue as diverse as the physical.

Religions of China.

The forms, dogmas and teachings of Religion professed by any people usually afford the best evidence of the character of that people—its mental attainments, its ideals, its rank in the family of mankind. This evidence is more or less conclusive in proportion to the active influence exerted by that religion on the daily life of the people.

There are in China three forms of Religion—or "Instruction" —as they more properly term it. These are Confucianism, Taoism, and Buddhism. The first two are indigenous; but the last is a foreign importation. That which wields the overwhelmingly preponderant influence is unquestionably Confucianism. As it is now believed and taught, it is not, properly speaking, a religion at all. It is essentially an elaborated ethical system defining the relations of mankind, and the duties implied in those relations. This ethical system is inextricably intertwined with the Confucian theory of government. It is impossible to eliminate the ethics from the politics, or to separate the politics from the ethics. The ethics are political and the politics ethical; for the government is patriarchal.

In language, whose brevity is unapproachable, and in a style as dignified and beautiful as that of any literature, the Confucian system sets forth man's duty to man. Chinese boys begin early and continue long, to commit to memory the *ipsissima verba* of these classics, which from first to last are without stain of impurity. In purity of sentiment as of language no classics can excel, few can

equal those of China. The literary classes are far indeed from the practical exhibition in their daily life of the teachings of these classics. Yet no youth can, year after year, by devout and close study, keep in ceaseless contact with this kind of literature, without being to a certain extent, influenced thereby. They are at least compelled to profess belief in the ideals, which they have to learn. When literary young Chinese become familiar with the beauty of the style and the nobility of the sentiment of their classics, it need cause us no great surprise if, in their ignorance of other literature, they are inclined to regard the peoples who know not their books, as necessarily inferior to themselves. All who are able to judge, declare that the Chinese classics are second in the excellence of their moral teaching only to the doctrines of Christianity. The literary grace and intellectual power of their classics are, in the estimation of the Chinese, beyond the possibility of comparison. When we remember that the Chinese regard as the crown of glory of their social structure the literary degrees won, after years of toil and keen competitive examinations, based on familiarity with these classics, we can understand the condescending conceit with which the Chinese literary class looks down upon the rest of mankind.

In matters strictly religious, the Confucian literate affects Agnosticism. A thousand years ago a remarkably able philosopher, *Chu Hi*, gave his life to the study, the editing, and the exposition of the classics. This philosopher was an agnostic of the type of the most extreme agnostic of recent times. The Heaven so frequently referred to in the classics, was declared to be the blue sky above. Whatever seemed to imply anything supernatural was explained away by natural phenomena, or by meaningless philosophical terms. Since his time, Agnosticism has been fashionable among the literary class in China. With the air of superiority usually associated with the literary habit, the modern Chinese scholar will not deny the possible existence of a supreme intelligent Ruler; but he will certainly not affirm it; for it is all beyond the bounds of his knowledge.

Yet though the Confucian system is essentially an ethico-political system, among its heaps of ethical grain we occasionally come across a rich diamond of religious truth, uncut, unpolished; but which the Christian can apprize at its real value, can furbish and put in its proper setting. These isolated truths have descended from the earliest dawn of Chinese literature; from the days when

Deism was universal, and when idolatry was unknown. Confucius transmitted those ancient truths. He did not profess to understand, much less to expound them.

The founder of Taoism was the co-temporary of Confucius, who on one occasion, visited him. Their fundamental working principles were opposite as the poles, and they failed to understand or appreciate each other. Confucius was essentially, and only, a practical philosopher. Mere speculative questions, however interesting, or on whatever subject, he directly and invariably thrust aside. Lao Kun, the founder of Taoism, was essentially a speculative and metaphysical philosopher; more akin therefore to the modern German school of philosophy. The word Tao signifies "Way," and is employed, as with ourselves, in both the literal and the figurative sense. It is the "road" on which we walk, or the "course" which we pursue in conduct. It is the foundation and primum mobile of all things. Out of it all things have been developed,—or should I say evolved? But though this "way" is the origin of all things, it is a passive not an active potency. It is not an intelligent agency, any more than is the cloud out of which comes the rain. It cannot be seen, heard or touched; nor can it in any way be described or known.

The morality connected with this speculative thinking was originally of a high order. Doubtless the moral teachings, transmitted from preceding generations, laid as fast a hold on the mind of Lao Kun as on that of Confucius. The phraseology of the two differs, the sentiment is virtually the same. Upon the whole, Taoism approached Christian teaching more nearly than even Confucianism. Confucianism did not recognise the duty of that kind of forbearance which can forgive injuries. Taoism did.

But the Taoist speculations, interesting and instructive though they were, speedily degenerated into the forms of investigation pursued by the alchemists in the middle ages. The questions connected with the perfectibility of man, by profound study and sincere humility, became merged in the question of how to make man immortal. The mountain and the ocean were searched for the medicine of immortality. For many centuries, Taoism set itself to toil in the mine and at the crucible to discover the pill which would drive away death. The superstitions connected with this form of religion have become ever more degraded, till now they have become mainly a series of magical incantations. By the incantations devised by secret sects of a Taoist nature, and by

corresponding gymnastic exercises, the Boxers were recently deluded into believing that they could stop the flight of a bullet or turn the edge of the sword. Hence the epidemic of madness which has seized Northern China. Among Taoist priests there are some men of remarkable attainments, of great learning, and of excellent life. They are the exception.

Buddhism was of Indian origin, and was a protest against the degradation and grossness of the prevailing Brahmanism. The founder flourished about the time when Laokun and Confucius were teaching their systems in China. Buddhism was too pure or too simple a form of religion for the Indians, who persecuted it out of existence and reverted to their degraded Brahmanism, which lives and reigns there to this day. There is a small sect in India still professing Buddhism called Jains; and Ceylon has remained faithful. It was probably by the first great persecution that hosts of Buddhists were driven into Thibet, whence they found their way eastwards into China. They obtained a place in China, and their spiritual descendants still cover the land. They are known as the "Black" Buddhists, from the colour of their robes. A subsequent persecution sent forth additional forces after Buddhism had undergone some changes in the land of its origin. These too, went through Thibet where their representatives still rule. Thence they pushed northwards into Mongolia. These are known as "Yellow" Buddhists, also from the colour of their robes. This form of Buddhism has the other name of Lamaism, and prevails in Ceylon as well as in Mongolia.

Buddhism was, like Taoism, rather speculative than practical. By meditation and isolation from the world, the Buddhist was to cure the evils of his own heart, and attain to a higher state in the long series of transmigratory lives which lie before him. Buddhism has not become degraded to the same extent as Taoism; though practically there is no very great difference between the lives of the two forms of religion. Its ideal still is to attain to what it considers perfection.

But Buddhism, with its many excellencies, is unlike any other religion, in that it is based upon, and saturated through and through with Pessimism. All life, known or conceivable, is imperfect, and therefore evil. Perfection is inconsistent with sentient being; therefore the highest aim of the Buddhist is the cessation of life. Towards the attainment of this hope all his most earnest efforts are directed. To attain it, he is willing to go through a

thousand lives of toil, of suffering, of religious exercises. His great hope is that at some indefinite future there will come an end to his misery in the annihilation of his existence.

There was some years ago a form of Buddhism published by Sir Edwin Arnold under the title of the "Light of Asia." That form of Buddhism is unknown in Buddhist lands. It bears that resemblance to real Buddhism, which the Belle of the Season bears to an old African hag. The Buddhism of Arnold is full of immense admiration for God, into whose Being the Buddhist is to be reabsorbed. Real Buddhism is blankly and frankly atheistic. In no part of it is there any hint which can, by any torture of exposition, be supposed to imply the existence of God. True it now has gods many; but they are its prominent teachers deified after their death, and they correspond exactly to the canonized saints of the Church of Rome. Along with some of the myths which sprang into being centuries after the founder of Buddhism had died, Sir E. Arnold interweaves many striking passages on the glory and beauty of love, which are, however, unknown to Buddhists. The love he describes is borrowed wholesale from Christianity.

There are great discussions as to what the real meaning is of the Indian term *Nirvana;* there is no possibility of discussion as to the meaning of its Chinese equivalent. It is the categorical opposite of Being. It means, and can mean only non-existence. In China the Buddhist hopes and toils and prays to heap up such an accumulation of merit, as will enable him to gain that perfection which will entitle him to annihilation.

Originally neither of these three forms of religion had idols of any kind. The use of images grew up in India among the Buddhists, in exactly the same way, and for the same reasons, as in the early Christian Church. The Chinese had no idols before the introduction of Buddhism. The cold, but wise, philosophy of Confucius, and the vain magic of Taoism, left a void in the Chinese mind which responded to the more sensuous worship of Buddhism. After a period of slow growth it became so popular that husbandmen left their plough, men forsook their wives and families, generals abandoned their armies, ministers of state threw away their portfolios. All ranks and classes rushed to the mountains to enter the monastic institutions of the Buddhists. So serious was the movement that affairs of state were disintegrated to such an extent, that special imperial edicts were issued to recall men to their duty.

Attempts are sometimes made to divide the Chinese people in certain proportions between the three religions. The Chinese themselves are never concerned with this abstruse matter. There is a small minority of real agnostics who profess to believe only in Confucianism. Tens of thousands of monks or priests, who inhabit the monasteries of Buddhism or Taoism, call themselves by these names, but the huge mass of the Chinese people insist that the three religions are one.

Though much of the teaching essentially belonging to these systems is mutually antagonistic, the Chinese believe equally in all. The Education of the Chinese is destitute of logic, of mathematics, and of the scientific accuracy based on these forms of Education. The critical faculty is not therefor developed. This will account for the apparent mental chaos exhibited during the past year in the contrast between the excellent ideals of China, and much of its public life. It will also account for the readiness with which the Chinese can believe contradictories.

But apart from this explanation, based upon the lack of critical examination and comparison, there is still another source of explanation to account for the Chinese believing in all three religions: Confucianism is a system like that of Plato or Socrates. Buddhism is a system of superstitious religious ceremonies. Taoism is concerned with the mysteries of magic, corresponding to the vagaries of western Spiritualism. It is not impossible to conceive a Christian who is a believer in Plato, who is also a religious devotee and an ardent Spiritualist. That is an exact parallel to the attitude of the Chinese mind towards his three religions.

But the hope of China consists in the fact that the system of Confucius holds the first place in the study and the esteem of the Chinese people. It will blend with Christianity in the immediate future, as did Platonism or the teachings of Aristotle in the past. The living sap of Christianity will enter into the dry, but shapely tree of Confucianism, and cause it to bring forth good fruit in rich abundance for the well-being of China.

VI.—*The Zulu of Nyasaland: their Manners and Customs.* By the Rev. DONALD FRASER, of the Livingstonia Mission.

[Read before the Society, 20th February, 1901.]

I SHALL take you to-night into British Central Africa, and describe slightly, a most interesting nation of warriors who live in West Nyasaland. To reach them we sail up the Zambezi, and the Shiré to Lake Nyasa. Landing at Bandawe, we strike inland for two days, climbing most of the way. After passing through richly wooded hills and valleys, we arrive at a great plateau, veined by constant sudden ravines through which rivers roar in the wet season, and trickle in the dry. The plateau is almost bared of trees, and is relieved by huge rocky hills which rise precipitously, from the plain. A low scrub covers the face of the land except where gardens are being cultivated, and the whole country is dotted by innumerable ant hills, each as large as a cottage. These are hoed by the villagers, and throughout most of the year, stand out gaunt and bear. Then the landscape is thirsty and inhospitable looking. The earth baked and hard, lies unclothed in the blazing sun. Cattle, sheep, and goats, wander about the river beds, and one looks almost in vain for any sign of vegetation to afford them food. But when the first rains come, the land breaks into smiling. The scrub puts on a dress of the softest green. The gardens and ant hills are covered with springing maize, and a thick garment of foliage, vegetation, and flowers, hides every vestige of the ground. Here we stand from 4,000 to 5,000 feet above the level of the sea. In the cold season, the thermometer falls as low as 40°, and in the hot, rises as high as 98°. But though the sun has a dangerous bite in midsummer, the heat is never oppressive, and the nights are cool and refreshing.

The people who live in this country, are a branch of the Zulu tribe, who started north 70 or 80 years ago on a great raid. The causes which led them to desert their own country are wrapped in mystery, and even the old men who can remember the days when they crossed the Zambezi, are unable to give any clear account of their starting. Probably it arose from one of the wars of Chaka, in

which his army was defeated. The warriors knew that they would be killed when they got back to the great Zulu despot, and so they fled north, fighting as they went. As they went along, they conquered and absorbed the tribes, gathering Swazi, Atonga, and a medley of people into the nation. They came to the Zambezi, and on the day when they crossed it they were terrified by a total eclipse of the sun. From the Zambezi they fought their way to Nyasaland, then striking west, they passed through the Senga and Wemba populations till they reached Lake Tanganyika. On the plateau there the first great chief died. He had become infirm in his latter days, and travelled about riding on an ox. At his funeral a terrible massacre took place. One section of the tribe, eager to observe the old bloody funeral ceremonies, surprised and murdered all the widows of the chief that their spirits might accompany the dead chief to the other world. This butchery aroused great indignation among the others, and the tribe split in two. The butchers remained at the S.E. of Lake Tanganyika, where they still are a terror to the surrounding people. The great part of the tribe however, again marched south. One of the sons of the paramount chief was appointed his successor. His name was Mombera. His four brothers, Mpezeni, Mperembe, Maurau, and Mtwaro, were given large and powerful sub-chieftainships under him. This led to a scattering and readjustment of the tribe. Mperembe remained as chief and conquerer over the northern people, keeping the wild Wemba, and other tribes under his suzerainty. Mombera, along with two other brothers, settled in the highlands to the north-west of Nyasa. And Mpezeni went south and gradually got so far separated from the others that his people became an independent and insolated section of the tribe. A few years ago, the British Government levied war on Mpezeni, and his country came under the British Government.

In the north also, Mperembe was sore driven through his separation from the main section of the tribe, and at last his people rebelled, and with the aid of the Wemba, drove him south to join hands with his brother Mombera the paramount chief. Around Mombera the great part of the Ngoni nation remained. Some of his head men started petty chieftainships to the south among whom were Mandala, and Mwasi. Their people are called the Central and Southern Ngoni, and are well known in the Blantyre district as labourers, but they are not Ngoni. Few of them can speak the Zulu or Ngoni language, and they are a poor effeminate and cow-

ardly people compared with the wild spirits who remained under Mombera.

This tribe is variously named Mazitu, Vikoko, Abangoni, and so on, and readers of Livingstone's 'Zambezi and its Tributaries,' will remember his frequent references to the wild marauding bands of Mazitu. The word Abangoni, by which the tribe calls itself, simply means "The people." They reckon themselves the blooded aristocrats of Africa.

The prefix *aba* before ngoni, is simply the plural form of the noun *umgoni*, a single man. The country is called Ubungoni, and the language Chingoni. For the peculiarity of the Bantu languages, is that words alter their number from singular to plural, and character from noun to adjective, not by changing the suffix but the prefix.

The language which the Ngoni speak is a slight modification of Zulu—but they only use two clicks—the dental *c* and labial *q*. In our schools therefore we use the Zulu literature in which there are already nearly 40 volumes, and the best of these are the translations left by Bishop Colenso. Zulu is however rapidly dying out, as the language of the slaves and of the surrounding tribes is becoming the vernacular of the common people. When Mombera's Ngoni settled down in the watershed of the Ruhuru, they soon made their presence disagreeably felt throughout West Nyasa. Their marauding parties were always out on the war path. Dressing in a frightsome garb of cock feathers, carrying a large shield and two or three stabbing assegais, they terrorised the neighbouring tribes. They used to sleep near some village which they wished to attack, and then in the early morning just before the light had come, with a wild war whoop they would sweep through the village, killing the men and the old people; then when they had seized the women and children and tied them together they would start back for the hills, driving with them all the cattle and sheep and goats that they could find. Their fighting was never done in the open. It generally took the form of a wild and sudden rush, and in a moment bleeding corpses were lying about, and the village was in flames.

The terrified people betook themselves to huge stockaded villages, others piled their villages in the lake itself. The Poka, and Henga fled to mountain fastnesses, and built on the edges of fearful precipices, the Senga fled to the Luangwa marsh and built great protected villages in the depths of huge thorn thickets. And the land became

barren with terror, till a great belt of uninhabited territory surrounded Ngoniland on all sides. It was sad to pass through this rich land, left to the wild beasts, to see mouldering smelting furnaces, and other signs of lost industries.

It was when the tribe was still in the height of its devastating tendencies that the Livingstonia Mission came into the country. At first the early pioneers were barely tolerated, and more than once it seemed as if they would have to abandom everything and flee for their lives. But gradually, imperceptibly the preaching of peace began to sweeten and purify the atmosphere, and the horrors of these fighting days became part and parcel of a dreadful past. Three years ago a new paramount chief was elected. At the great council the wild spirits of the tribe tried to rouse the people to celebrate the coronation with a great raid. They danced, threatened and raved, but the younger chiefs, themselves Christians, spoke eloquently for peace, and in the end peace prevailed, and the death knell of the past was sounded. And now there is no more settled, peaceable, law-abiding people in Central Africa. And this victory has been won not by the rattle of Maxim guns, not even by the wisdom of diplomacy, but by the daily teaching of the Gospel of Peace.

The political structure of the tribe is strong and conservative. The father of all the people is the paramount chief. His authority has descended to him through a long line of ancestors, the eldest son of the principal wife succeeding to his father's position. In some cases the head wife has had no sons, then she adopted a son of one of the other wives and he became the heir. The chief's power is nominally absolute, and he is surrounded with a certain regal dignity. It is impressive to see the aristocratic majesty that a great chief can maintain. Though his regal robes may not be more than a dirty bit of blue calico, which is not worth fourpence, he walks with a scornful dignity that any European prince might envy. When he listens in court to some great indaba his face is expressionless as granite, with an affected indifference he drinks from his great calabash of beer, and ladles ounces of snuff into his nostrils, while his poor subject pleads with passion and eloquence over a matter which may mean death or life to him. Yet behind his nominal power he is controlled and restrained by the voice of his council. His succession may be plain and acknowledged, yet he cannot assume the reins of government until he has been nominated by the sub-chiefs and councillors. Our present chief had to

wait for six or seven years before the procrastinating headmen could lay aside jealousies, and actually place him in the authority of his father. Then when he is crowned he cannot sit in judgment or give a decision unless his councillors have been summoned, and have deliberated with him. Many a time in the old fierce days the councillors and chief argued and defied one another for weeks at a time over the question as to whether the white man was to be tolerated in the country, and it was the strong affection of old Mombera for Dr. Laws, and Wm. Koyi which alone held in the dogs of war, and prevented his councillors from going forth on an exterminating expedition. Yet in spite of the great power of the chief he lives as father of the people with all the villagers as his children. His house is like their own, built right in the centre of the village. The poorest slave has access to him, and he hands his beer pot or his snuff to the meanest villager when he would show him friendliness.

Under the paramount chief there are four great sub-chiefs, and each of them has his councillors and headmen. Then these headmen have each a group of villages under their control. They hear and dispose of petty quarrels between the villagers. Cases in which headmen are involved go to the sub-chief, and cases in which the sub-chiefs are involved, and all great tribal affairs, go to the paramount chief. The tribal council is an impressive sight. Just before I came here I had the privilege of being present in one of these great gatherings of the tribe. It had met to discuss the advisability of coming under the British Protectorate. The great chief, Chimtunga, had sent out his messengers to call to council all the sub-chiefs and headmen. They marched into the chief's kraal on the appointed day, each sub-chief followed by his councillors and hundreds of armed warriors, all walking in single file, and dressed in their gaudiest clothes. They sat round the kraal till thousands were present. By-and-bye the paramount chief walked in, followed by his brothers and council. He was greeted by a roar of salutation, and took his seat. When the case was opened, and the subject introduced, the fathers of the people rose one after the other and saluted the chief, and then addressed the people. The speakers walked up and down, speaking with considerable incisiveness and eloquence, their language full of metaphors and traditional allusions. Then the chief spoke, closing the discussion. Immediately it was ended and the royal salutation given, a warrior leapt into the circle with a war cry, fell

down at the chief's feet, and with a shout dashed up again and danced a furious war dance. His eyes fixed and staring with passion, every muscle distended, he stabbed into the air with his spear, tossed the dust of the kraal about, and leapt hither and thither in a frenzy of passion. All the while he kept shouting his battle-cry, and the thousands of fighting men around beat their spears and chanted a chorus. When he had exhausted himself, another headman leapt into the circle and went through his own peculiar wild dance, and then another and another, and for half-an-hour or more these fantastic exhibitions were maintained. Then the chief rose. A great roar of salutation greeted him. Gathering his clothes about him he walked in procession from the kraal, and the council broke up.

In the olden days the power of the chiefs was maintained by a wholesome dread of his warriors, and the laws were enforced with a consistent severity. One result of this is that the Ngoni tribe has always had a higher standard of morality than any Central Africa people. Some persons were stealing mission cattle and complaints were made to the chief. After a time a thief was caught, and then in spite of the pleadings of the missionary the highest penalty was meted out to him. He was hanged on a tree opposite the mission house, and it was forbidden to remove his body. The hyenas wore a path round the foot of the tree trying to get at the carcase, and there he hung, a terrible example to the neighbourhood, until the white ants ate the rope by which he hung, and the body fell to the waiting hyenas.

I have seen a chief receive news of the adultery of one of his wives, turn to his executioner, and give him instructions, and in a few minutes both man and woman were lying dead outside the village. I have myself begged for the life of a woman who had sinned, and she was spared only after a great fine in cattle was levied instead.

These were harsh and terrible punishments, necessary for rough times. And now when the chief is loosing some of his old authority, and dare not exercise capital punishment because of the overshadowing British Government, one fears that except where the power of religion has taken the place of the old dread, a weaker morality is apt to sap the vitality of the tribe. The punishments were not arbitrary. They were fixed by precedent. And all the past quarrels for forty or fifty years back would be quoted to prove the right of a plaintiff or defender. And now

when the death penalty can hardly be exacted, or compensation made in the delivery over of slaves, they find it hard to satisfy demands and make a show of justice.

Now let us speak of the social life of the people. The Ngoni differ from most of the Central Africa tribes in their habit of living in large unprotected villages. The tendency of most of the other tribes is to scatter themselves in very little hamlets over a wide area, with scarcely a path of communication between the villages. Where war has harassed them they have built huge stockaded villages for their mutual protection, but as soon as assured peace has come again, the towns have split into numerous distant groups of houses. This seems to be caused by the dread and mistrust of one another which the people have through their superstitious belief in a evil eye, and in witchcraft, and through the perpetual little quarrels that arise. A carrier who was accompanying a friend of mine described this state very wel when they passed a little village of four huts, and then a few hundred yards farther on an isolated hut. Holding up his hand he cried, "Look at Mr. Thumb saying to Messrs. Fourfingers, keep your distance."

The heart of a Ngoni village is the large circular cattle kraal. There all the court cases are tried, there the visitors are received, and there the dances are held. Round the kraal the village of beehive huts is built in regular rows, and then immediately outside the gardens begin. The village life takes the place of family life, and the headman is father of all the people. The boys after they have attained to twelve years of age or so live in huts by themselves, and the girls in huts on the opposite side of the village. These girls' quarters used to be most sacredly guarded, and any man found in their enclosure after dark could be killed.

The great part of the Ngoni nation consists of domestic slaves. They are people, or the descendants of people, who have been captured in raiding expeditions. But their position is not a hard one. If they are discontented they may change masters. They give their masters a little free labour, and in return are made members of his family; he espouses all their quarrels, looks after them in sickness, and shares some of his superfluity with them, but they have to share some of their necessities with him.

Polygamy was the universal custom of the people until recently. Now hundreds of polygamous unions are being dissolved every year. But in the rougher days polygamy was a necessary

condition. It helped to maintain the comparatively high morality of the people. And it was never allowed to go to the extremes that the Tonga or others went to when a single chief would have 100 wives. The expensiveness of marriage put a limit on a man's matrimonial ambitions. Yet polygamy was essentially an evil custom. It was based on sensuality and on indolence. And when Christianity comes bringing industry, and self-restraint, it must disappear.

In the old days the chiefs would not allow the men to marry till they were over thirty, and the women were strong and full grown. This preserved the splendid physique of the tribe. But now the laxer customs of the Central Africans is telling on the Ngoni, and one of our hardest tasks is to absolutely refuse marriage to couples whom we think to be too young for this serious responsibility. I have a marriage service every Tuesday, at which I usually unite eight or ten couples in holy wedlock. But these have first of all to come to me that I must judge by appearance, for they cannot tell their ages, whether they have reached the stature of manhood and womanhood. Then if I am satisfied the banns are published and they are married.

But before a man has reached this stage, he must first pay his father-in-law a dowery for his daughter. The value of the dowery varies, according to the rank of the family into which he would marry. The daughter of a chief might be worth to her father as much as twenty cattle, while a slave might only receive two or three goats. This also was a great restraint on early marriages, for a man could not marry until he had time to gain a little wealth, and pay for his wife.

The position of a wife of an aristocrat was one of considerable ease and dignity. She had to work certainly, but she had also a considerable following of slaves to assist her in her labours. But the position of the wives of the commoners was little better than that of slaves. When the rains came on the husband sallied out with his wives. He sat on an ant hill and snuffed, and from this exalted position directed the labours of his wives who hoed.

In this the Ngoni were less noble than their neighbours, for many of the surrounding people think it is a disgrace to send the woman to the gardens. When the harvesting came, the women went to the gardens and reaped and carried home the grain, while the husband prepared the barns. And women pounded the grain and cooked it. While the men had the pleasure of eating it.

Yet the position of the old women of the village was a highly honoured one. The mother of the headman was almost more powerful than her son. And we always take good care when we enter a new village to win the kindly favour of the old grandmother first of all. Then we are sure we have found a way to the son's heart. One of the most beautiful things in our tribal life is the honour which is paid to the grey hairs of the village. The bent and helpless old men who lived through the glorious fighting days, and understand all precedent and etiquette are the judges and councillors. And no case can be tried, no decision can be made, until the old men give their presence and their opinion. It is hard when the young are leaping ahead of their fathers through education to maintain this veneration for the elders. Yet it is the very backbone of the tribe. There is nothing more contemptible than an African or an Asiastic with a veneer of education who affects to despise the elders of the village. But I know no more pathetic sight than our afternoon schools where grey-haired men and women may be seen peering through faded eyes trying also to learn to read and keep abreast of the young and alert life, while the sun goes down in their eventide.

The Ngoni were first of all a fighting people, and then a pastoral. Their land affords splendid pasture for cattle. And they take great pride in their herds. Round the cattle kraal centre all their ambitions, and highest delights, and best intelligence. They sit and watch the cattle going out in the early morning and coming in in the evening, and know every spot and colour of their beautiful animals. The quietest and most peaceful sight I know is when the sun goes down, and the fierce heat has given place to the welcome cool of the evening. Then you will hear the music of reed pipes, and looking up you see a long line of sleek, solemn cows, with large silken dew laps, and fat humps, slowly coming up the village path lowing for their calves, while boys ride on their backs sitting or standing upright, balancing themselves carefully and blowing on their pipes. Before and behind them runs a troop of goats and sheep bleating with such a human cry. In a moment the village is alive—sheep and goats are chased back and forward till they find the huts where they sleep with their masters. And boys run out with wooden pails into which they milk what the calves have not sucked from their mothers.

The art of cultivating the ground is only now being learned by the Ngoni. Formerly this was the work of the slaves. The masters know how to kill not to till. The soil is fairly rich though not nearly so fertile as what is found at the lake shore and in the deep valleys between. Maize is the great crop. But owing to the devastation of locusts for several years in succession, the Ngoni have learned to plant also reserve gardens of kaʿava, for the locusts and drought can scarcely affect this crop. A great variety of vegetables is cultivated, peas, beans, tomatoes, pumpkins, and so on. I have counted a variety of twenty-two different vegetables in the gardens beside one village.

These vegetables are used as relish, but the staple food is always maize porridge, and a tasty dish it is. The maize is well cleaned, ground into a fine flour, and when cooked by a clever woman makes a most tempting dish of white porridge. The relish may consist of a piece of stewed fowl or goat, or well boiled vegetable. The greatest dainty that was ever offered to me was a dish of lovely maize porridge with relish of stewed caterpillars. I did without the relish on that occasion. An interesting thing about these caterpillars is that they live on the top of trees, and the natives, to get at them, will hew down the tree. You can see how delicate a dish it makes if every caterpillar in the dish has been got at the cost of a tree. They take the place of the old European dish of peacocks cooked in their feathers.

No native thinks he has eaten until he has had his porridge. A missionary whom I know once unwisely gave a feast to his elders, feeding them on European food. They ate till they could eat no more, then stretching themselves, and after politely expressing their satisfaction by audible sounds of satiety, they rose and and said, "We must now go home to our porridge."

The maize and vegetables are grown with very little trouble, but there is also a species of millet which is largely cultivated, and at great cost to the country. The ground has to be carefully prepared, trees are hewn down in the hot season, and left to dry up in the blazing sun. The whole patch of garden is covered over with these trees and the branches, then when the first clouds appear, the wood is fired. For a day it blazes, and then during the gathering of the clouds the atmosphere is thick with the smoke of burning trees. The rains come and wash the carbon into the soil, and it makes an excellent fertiliser. But the crop exhausts the ground in two or three years, so another patch of

forest is cut down and burnt, and another garden cultivated, and so the country is rapidly being deforested. The crop is largely used to make a heady beer, and although Central Africa has been happily saved from the curse of European liquor, the native beer is a great source of big drunken bouts. Heavy drinking, however, does not bring the evil effects that brandy drunkenness would entail. The drink is a nutritious and a very sustaining food, I know some of the old chiefs who are drunk almost every day of their lives by midday, yet they bear up wonderfully. But these drunken bouts, when whole villages run riot, are the source of nearly all quarrels, adultery, bloodshed, and every outburst of passion. We have had to denounce the beer drinking as a menace to the social order of the country, and for lack of the strong restraint of the British Government, which forbids the cutting down of trees, we have preached against the deforesting of the land as a wicked improvidence. The native church has, of its own initiative, taken up the question, and enjoined on the members total abstinence, and the preservation of the forests.

Three or four months labour are sufficient to provide a family with food for the year, and the sale of a sheep or a heifer will buy all the clothes the family requires. There is therefore little necessity to work, and the tendency is to spend the months lounging about the village, talking and trifling. Now, happily a more industrious period is waking, and larger ambitions for cloth and for stock, are drawing out the men to work. As a mission we insist on the duty of labour, we refuse church privileges to a man if he cannot show that he has been engaged for some months each year at some labour centre doing honest work. No moral good is ever effected by pampering African pride and indolence, and one of the first lessons Christianity has to teach the native, is the dignity of labour, and the absolute necessity for the labourer to be industrious and honest in the discharge of his work. A penny a day is the ordinary wage we give a labourer, and even the great majority of my 220 teachers do not receive more than 1/6 a month.

Of course many of the Central Africans have industries of their own, smelting, basket making, cloth weaving, wire pulling, and so on. But the Ngoni were a handless people until they got a spear in their hand. Then they drew themselves up as men, and defied the universe. Yet this martial life had an ennobling effect on them. It is a curious thing to notice, and a fact which was

borne out in Roman days also, that the handier, and more artful and skilful people have usually a lower social morality than the fighting races. Our Ngoni came to Nyasaland as a moral blessing. The ordinary obscenity of the indigenous people was not for a moment tolerated among the Ngoni. It is very appalling to hear and see how degraded were the Tumbuka into whose land they came. A people among whom virginity was unknown, where family relationship was no defence, where men and women lived in an atmosphere that was charged with vice. But when the Ngoni came, many of the foul practices of the Tumbuka were punished with death. Their obscene dances were prohibited, many of their superstitious customs were banned, and generally a higher type of morality was superimposed.

The aristocratic Ngoni is a gentleman through and through. His word is absolute. When he gives a promise you may fearlessly rely on it. He does not steal, nor does he intrude on your privacy. I have heard the old men storm in a village because some boys stood around staring at me, or speaking. Before a superior they should sit down, and remain silent, or only speak in whispers. When they address you they always give you your family name of honour, or if they don't know it, round off each sentence with a "sire." When you come into a village you sit at the gate of the cattle kraal and wait for your reception. After a long time the elders of the village appear. Their courtesy is that the longer the wait the greater the welcome. For if they come out quickly they seem to say you had better clear out quickly. When they appear they sit down at some distance, and remain silent. You must not speak till you are spoken to. After a decent interval, they come forward, sit down, and leisurely say, "We see you, sire." Then you reply, "Yes, sire." That is the whole courtesy. Conversation may now begin. When you would rise to go, you first of all say, "Remain in peace, sire," and they reply, "Yes, and go thou in peace, sire." It is very courteous and friendly, and they accompany you along the path a little way, and again send you off with salutation.

Their village life is not without interests and amusements. During the day in the head villages there are continual trials in open court—trials which last for hours and days with continual speech-making. In the evenings the kraal echoes with the chorus of village dances. Quite the prettiest and most delightful dance is the village competitive dance which is held during the day. A

challenge is sent from one group of villages to another. And on the day appointed the strangers arrive walking in procession. The girls and women are dressed in their gaudiest clothes, and their heads and arms are decked with bright coloured beads, and the claws of lions and leopards. The lads carry dancing sticks and miniature shields. The strangers open the dance. The girls standing together and holding reed wands in their hands sing in chorus, while the men arranged in a great semi-circle dance and sing. Their dance is wonderfully energetic and graceful, and is executed with a rythm and unison which is fascinating. You can hear a long way off the hundred feet come down on the earth of the kraal with a thud as of one man. When they have danced for about an hour they give way to their rivals. The home villagers step in and dance for another hour. And so on they go from ten o'clock till about four. There is no mingling of men and women. And the whole exercise is chaste, healthful, and beautiful. It is quite the show piece of our village life.

And now a few remarks in conclusion on their religious beliefs. I do not intend to say much on this point as one only can get at the inner meaning of their faith after long and careful investigation, and with a thorough knowledge of their language. Their religion was not formulated. If you ask them about it they can tell you little or nothing. They will deny that they knew anything of God until we came. Their observances were scarcely recognised by themselves, they were the spontaneous and almost unconscious expression of a people groping after the unknown God if haply they might find Him. They recognise a spirit who presides over the universe.

They have a name for Him which means the great great one. But the ordinary name is the one which south of the Zambesi is used for all white men, and seems also to imply some feeling of wisdom and greatness. But they seem to have no idea of God's imminence in the world. He is rather the mighty far away Spirit to whom men cannot come. Along with this, homage is made to great mountains and ancient trees, and to the strong elemental forces, as thunder and lightening. But this seems to me to be an addition which has come through their residence among the Tumbuka.

The great pervading article in their religious life is reverence and dread of the ancestral spirits. The whole land is full of their presence. And offerings are continually made to them to appease

their anger and propitiate them. Yet this recognition is not made in any degree of affection but in the times of dark necessity. When the rain has not fallen, when locusts swarm and eat up their crops, when sickness and death are abroad in the village, the spirits are working out their vengeance for being neglected. Then they are remembered and sacrifice is made. There are also certain ceremonial observances on important occasions. Before the gardens are hoed, and when the reaping time draws near; if an army is going out to battle, or when a coronation takes place, then prayer is made. The confusion of the old and new ideas was amusingly illustrated at the last coronation ceremony, when Mperembe, the eldest sub-chief, sacrificed a bull, and offering it to the spirit of the dead chief prayed him to bless the new chief, then added, "and, O Mombera, bless the teachers when they go about teaching the people the words of God." There was something very beautiful in this recognition of Christianity as but a fuller shining of the dim light they had.

Their old men are full of stories and traditions, some of them are uncommonly like the stories of Uncle Remus, and others with a curious echo of Old Testament story. There is a hill near Ekwendeni, where tradition says a great tower was built by the Tumbuka to reach into the moon. But the white ants ate away the foundation and the tower fell and the people were killed. I passed below this hill when I was on my way home, and chaffed my carriers on trying to build so great a tower with wood. They laughed, and said, "But do you know the story of the hill over there?" pointing to the north. No, I said, what is it? And they told me how that long ago the Tumbuka found the country too narrow, so they decided to climb into heaven and cultivate new gardens there. So they gathered the nation together and cut down all the trees, and began to build a huge tower on this hill. When they had got a great way up, some cried "Stop, we need build no more. Here is a ladder coming down out of heaven." And they looked up and saw great roots hanging down. So the people caught hold of these roots and began climbing hand over hand up to heaven. But suddenly while they were all climbing, the roots broke, and the nation fell to the earth and was snuffed out.

Like other children of nature there are men and women in the tribe who seem to have a wonderful gift of second sight. Forty years ago a regiment went out on a great raid. The witch doctor in blessing them told them that they would meet a white man

rising out of the lake, this was the spirit of the fathers returned. Now they had never heard before of men. with white skins. But one day when they were burning the Henga villages, suddenly they came on David Livingstone and his party on their first journey of exploration on the Lake. More than once I have heard them tell how this wicked hag had cursed her enemy and said that beneath that tree the lightning would strike her, or some other terrible prediction, and there came a strange fulfilment. Such curious accidents gave to witch-doctors and others a dangerous power over the people. And in spite of their constant failure to bring rain, or ward off sickness and death, their reputation was kept alive by the memory of one or two ancien successes, and by playing on the terrors of the people. Unfortunately these superstitious terrors led to miserable atrocities. The witch-doctor was always called in to detect crime which was not patent. He brought his poison pot with him. He might accuse whom he pleased, and the only way the accused could clear himself was by drinking the poison. If he became sick and vomited then he was innocent. If he died he was guilty. When a chief died his spirit was not allowed to go to the other world alone. A great fight was organised and many were killed, that they might be with him. Or the women and slaves were taken and buried alive with him in the pit.

The twin children and those who cut their upper teeth before their lower, or any who showed any abnormality were buried alive in the sand of the river, or were cast out to the hyenas.

These atrocities are happily becoming matters of history. We seldom now hear of them, and when we do, it sends a thrill of horror through many of the people.

Now a great change is coming over the people. They are the only independent tribe is Central Africa, living under their own chiefs. But the old military days have passed away, and with them much of the great power of the chiefs. The old men see it, and shake their heads, but do nothing to readjust the state. But the young chiefs, most of whom are readers and Christians, have set themselves energetically to try and remould their government. Our most capable and powerful sub-chief, who is himself an elder of the church has recently established a regular hut tax, and has formed a police force. His police bring criminals to justice, enforce his judgments, prohibit the people from cutting down trees, and during slack seasons go through the villages, and where

they find dirt and untidiness compel the people to turn out and sweep the village, and rebuild their houses.

Education is spreading at a great rate, and there are fifty schools already established among the people with about 7,000 scholars in attendance. These pay fees for their attendance. And so great is the thirst for reading that last year more than 4,000 volumes were bought by the people.

A Christian church is rapidly growing up, and at certain religious seasons a great congregation of over 7,000 people may be seen gathered from all quarters.

Yet it would be a pity if with this inrush of new life the old tribal characteristics were lost in a wretched caricature of European methods. There is nothing more slovenly than a lithe athletic African dressed in European cast off clothing, or more repulsive than a lad trying to be an Englishman when he should be an Ngoni proud of his nationality. And this is one of the most serious problems that is constantly before us, to guide this people in their formative period, that in the end they may not be denationalised, and made hideous and ridiculous in a distorted and unnatural mould, to preserve all national customs which are not evil in themselves and yet evolve a people honest, industrous, intelligent, and Christian, who will have some harmonious and beautiful part to take when the world's orchestra is filling up to play its symphony of peace and prosperity.

VII.—*Technical Colleges in Germany and in Glasgow.* By Prof. A. MacLay, B.Sc., C.E., M.I.Mech.E., Glasgow and West of Scotland Technical College.

[Read before the Society, 19th December, 1900.]

"Das Neue dringt herein mit Macht, das Alte scheidet."
Schiller's Wilhelm Tell.

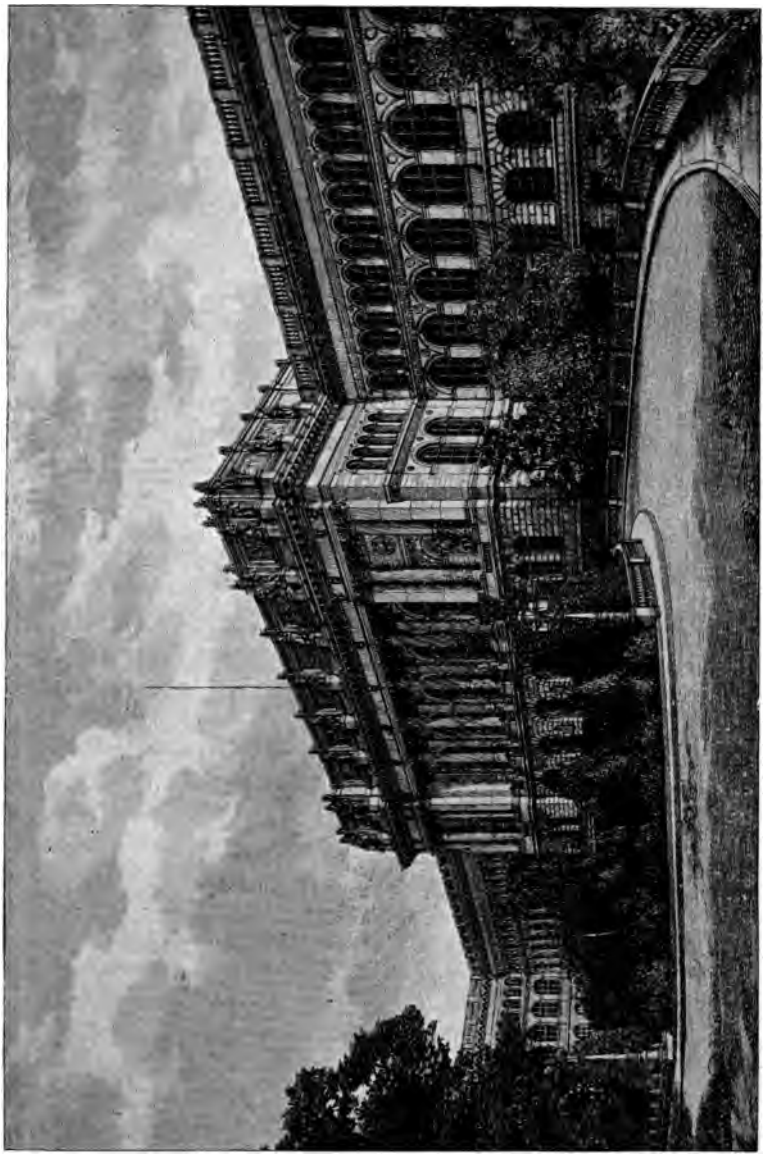
"The old order changeth, yielding place to new,
And God fulfils Himself in many ways,
Lest one good custom should corrupt the world."
Tennyson's Morte D'Arthur.

"The North German, when he sees that things go wrong,
will at once return to first principles."
Lord Rosebery's Glasgow Rectorial Address.

I. Introductory.

If we could take a comprehensive and deep enough view of each case, in its relation to all the others, it would probably appear that every nation has had a mission in history. But whether this be true or not of all nations, there certainly have been some of which it can be said, that in virtue of one or more supreme qualities, which they possessed as national characteristics, they left other nations behind and reached higher levels of development, in various directions, than had ever been before attained.

The Hebrews preserved the monotheistic idea and the ideal of Righteousness, the Egyptians were mighty in Great Works, the Greeks had a fine sense of Beauty of Form in Art, the Romans were strong in Law and Order, the Phenicians, the Venetians and the Dutch were great in Commerce, and we are said to have a genius for Colonisation. But it appears to me, that no nation of the present day is going to become so much of a Teacher of other nations, as the new German Empire, which sprang into existence only 30 years ago. In virtue of that virile quality of "thoroughness" of his, the German is now ahead of all others in Method, System and Organization. His military system has proved itself in three wars, his school system has long been an object of



THE ROYAL TECHNICAL HIGH SCHOOL, CHARLOTTENBURG, BERLIN.

admiration for Educationalists in all parts of the world, and in these latter days, it looks as if he was going before long, to take the lead in Europe, in the Industrial World and probably become also a formidable rival to Britain in Shipping.

If this is admitted, then it behoves us to examine for ourselves, from time to time, what he is doing along various lines of activity, and to report to those who have not had the opportunity of seeing for themselves. In what follows, I try to show briefly his very advanced position along the lines of the Higher Technical Instruction.

II. HISTORICAL.

In accordance with their present advanced position, it is only as one would naturally expect to find it, that the people, who have had most experience in connection with Technical Colleges, are the Germans. It was in Brunswick that the necessity for Technical Education was first clearly recognised and that an attempt was made to meet it by the establishment of a College there in 1745. It was in Baden, so far as I have been able to make out, that the idea of an Institution, on the lines of a Modern Polytechnic, (in the *continental* not the *London* sense), was first worked out in 1832. Lastly it is in Prussia, that the system has received its crowning development and attained its greatest success, in the magnificent pile at Charlottenburg, near Berlin; (Fig. 1).

The Collegium Carolinum at Brunswick was founded by Johann Friedrich Wilhelm Jerusalem, Vice-President of the Consistory, in 1745. This far-seeing man won over his prince and his people to the view, that it was necessary to provide higher instruction other than that given in the Universities. In their four Faculties of Theology, Philosophy, Medicine, and Law, he held that the Universities did not meet all the requirements of the time. He considered that an Institution was needed in which the "Studium der Technic" or training for the higher callings in practical life, should receive equal attention with the "Studium generale." But just how far or how well he was able to embody his prophetic aspirations, as regards the character of the instruction given, I have been unable to ascertain. That he was not a visionary or hopelessly out of touch with his time is shown by the College Album of that early date. The names of eleven students are entered in the record of the first three months after the start. And except for a short time, during the foreign domination under Napoleon

(1808-14), when the College was turned into a military school, it seems to have kept steadily in view the intention of its founder. It may therefore be said that the present excellent Technical High School at Brunswick with its great building, is the natural growth and development of Abbot Jerusalem's school of 155 years ago.

Technical Schools have now been given such a high place on the continent, that the honour of being the first has received some attention, but like that of being the birthplace of Homer, there are several claimants—the Prussians for Berlin, the French for Paris, the Austrians for Vienna, and Glasgow has also had its word to say. I believe however that the following is the true order of precedence. The Collegium Carolinum, Brunswick 1745, the Realakademie, Vienna 1770, L'Ecole Polytechnique, Paris 1795, Anderson's Institution, Glasgow 1796, the Royal Institution, London 1799, the Bauakademie, Berlin 1799.

As regards the second point, referred to above, the modernised form of Technical School or 'Polytechnic," there is on record a letter from Nürnberg of a Baden merchant, by name J. J. Schnell, of date 24th October, 1821, which reads exactly like one of those, of which the Editor of the "Glasgow Herald" has received so many of late years, if one simply interchange the adjectives "English" and "German," in reading them. He wanted those in authority to "think on ways and means of perfecting the German industries, so that they may supply as good wares as the foreigners." "Our artisans" he went on to say, "must receive the same instruction in technical matters, as the English and French, if we would prepare as good wares." "Constantly thinking of the well being of my Fatherland, I have designed the plan of a *Polytechnic Instruction Institution* for my native city." This was the beginning. Ten years later, in this same city of Karlsruhe, Nebenius, minister of the interior of the state of Baden, worked out the plan of a Technical College, and it is a great tribute to the genius of this thinker, that with all the developments of the past 70 years, the Technical Colleges of Germany still preserve the main features of his scheme. These were that the Institution was to consist of a number of complete units or sections (in its case of an Engineering School, a Building School, a School of Forestry, a Higher Industry School and a Commercial School). 2ndly, it was to be placed under the control of a Minister of State; but that 3rdly, the immediate direction was to be intrusted to representative members of the Teaching Staff.

Technical Education in the highest sense was evidently considered in Germany as too important a matter to be satisfied with a few classes tacked on to the University system or even to be represented by a Science Faculty in the Universities. Only three of the 22 Universities of Germany have made any move in the separate science direction, even to the very limited extent of making Mathematics and the Natural Sciences a separate faculty, instead of a section of the Philosophical Faculty, as formerly. A complete new departure was seen to be required. Not a Science Faculty but a Science University was needed to cope with the magnitude and the variety of the interests involved in this 19th century life of ours. And if this was true in the first half of the 19th century, it is immeasureably more so now. This then is what the Polytechnic has become in Germany. It has long since left the idea of a mere Trade School far behind. Even the name "Technical High School" is somewhat misleading. It is beyond that, it is a Science University of the most complete kind, as will be shown in what follows; and a most important further step in the historical development of the type took place last year by which these institutions have now obtained the crown of their ambition. The recent "promotion right," enables them to confer the "Doctorate" upon engineering graduates. This is a mighty break. It is, I believe, the first time in the history of Europe that such a degree has been conferred outside of the Universities.

III. THE PRESENT POSITION.

There are now nine such Technical Science Universities in Germany. These are situated at Charlottenburg near Berlin, at Hanover, Brunswick, Aachen (Aix-la-Chapelle), Darmstadt, Karlsruhe, Stuttgart, Munich, and Dresden with a total attendance in the winter of 1897 of between 10,000 and 11,000 students. Those that are already built have had to make considerable extensions and new ones are in contemplation. The steady growth of the system cannot be better illustrated than by a reference to the figured ground plan of the College at Karlsruhe. (Fig. 2). The enclosed figures on the plan show the dates of successive extensions and alterations from 1836 to 1901. Everywhere one goes it is the same. It is abundantly evident that the various states of the empire are straining every nerve, to keep abreast of the requirements of the time. The impression made by a tour among the colleges is such that one could wish that our states-

men and men of influence and manufacturers would take a turn through them and see for themselves how much thought and energy and time and money is being put into this matter of national and international importance. Patriotically one comes back with a fear, that cannot be shaken off, lest we should waken up all too late, to find that both our industrial and commercial supremacy have been seriously undermined, while we are still pottering away with half measures and no system and our sublime reliance upon voluntary effort alone, in a matter of vital importance to "an imperial race." In America the difficulty is solved by the millionaire, in Germany by the State. In Britain we keep straining our eyes, but as yet the cloud that is to relieve the famine is no bigger than a man's hand. Even when the fertilising shower comes along, we need not expect a crop, such as I have been describing for many a year. All the schools enumerated have been in existence and working more or less on their present lines for more than a generation, some of them for half-a-century or more. Whole sections have been in operation for 30 years that are yet little more than names to us or are only represented in our colleges by one man. Courses are taught that are scarcely touched upon here. There are 20 professors in the Technical High School at Charlottenburg, for example, in a section which is only represented by one professor in our Technical College. I refer to the section in Architecture. Again in a subject of such supreme importance to this city as Mechanical Engineering, which is represented in the Technical College by three professors, the representation at Charlottenburg is 16 professors, 7 lecturers of professorial rank and 16 other teachers. But it may be said that it is not fair to compare Glasgow with the college in the capital of the empire. Still, Glasgow is the second city of *this* empire. But let us take one of the smallest of the schools—that at Aachen (Aix-la-Chapelle) for example. There in the same section of Mechanical Engineering, there are 7 full professors, 2 lecturers of professorial rank, and 6 other teachers. In whatever direction we turn enormous disparity comes out. (See Tables I. to V., column 2.) Thus at this same comparatively small school at Aachen, the subject of Chemistry, which is represented in the Technical College by two professors, has 10 lecturers assigned to it. It is everywhere the same in all the sections. Each section would of itself be considered a highly organized and very complete college, as size and numbers go here.

IV. SECTIONS.

And yet there is no school, which has fewer than five of these sections. They *all* have complete sections in Architecture, Civil Engineering, Mechanical Engineering, Chemical Technology, Mathematics, and General Science. And in addition to these nearly every school specializes in some other department, in most cases with some reference to the leading industries or requirements of the province. Thus on account of there being no Technical High School as yet at Hamburg, Stettin or Dantzig, there is a sixth section with six professors for Shipbuilding and Marine Engineering at Charlottenburg. Munich has a section for Agriculture, Karlsruhe one for Forestry, Brunswick one for Pharmacy, and Zurich, which may almost be considered a German College situated as it is in German speaking Switzerland, has a 6th for Agriculture, a 7th for Forestry and an 8th for Military Science, while in all the schools Electrical Engineering is either at present a separate section or is in the way of becoming one.

But even this is only part of the story. As associated sub-sections, Mining and Metallurgy go along with Chemical Technology in a department of 12 professors and 10 other teachers at Aachen) Metallurgy along with Chemistry in a section of 41 teachers at Charlottenburg, 19 at Munich, 14 at Stuttgart. Works Engineering goes along with Chemical Technology at Dresden in a section of 20 teachers. Pharmacy and Foodstuffs are sub-sections with Chemistry at Karlsruhe and Stuttgart. Food Analysis, Sugar and Fermentation Technic are sub-sections with Chemistry, in a department of 18 teachers at Brunswick, and at the same school Textile Industry is a sub-section with Mechanical Engineering. In addition to these sections and sub-sections, the majority of German Technical High Schools have Lectureships in such subjects as Political Science, Jurisprudence, Hygiene, History of Art, History of Literature, also for French, English and Italian Languages and Literatures.

V. COURSES.

As regards the educational territory covered, it would take up the greater part of my time this evening to describe fully the work of any one section alone. A few generalties must suffice. Take for example a medium sized school like Hanover (See Table I., with a total of 1,550 students last session. There were in connection with the instruction in the Architectural Section 84

separate courses given, in Civil Engineering 60, in Mechanical Engineering 63, in Electrical Engineering 70, in Technical Chemistry 47, in Electro-chemistry 56, and in the General Science section 48, numbers sufficiently formidable to make comparison quite out of the question with any similar set of courses over here, even although we included every half course or short course given in connection therewith. But I dare say the nakedness of the land has been already sufficiently exposed in this connection, in making reference to the number of teachers. It is easy to see, from a review of Tables I. to V., columns 3, 4, 5, that even

TABLE I.—*The Royal Technical High School at Hanover.*
SESSION 1899-1900.

(1) SECTIONS.	(2) Lectures.	(3) Courses.	(4) Instruction. Weekly. Lectures. W.	(4) S.	(5) Hours. Practical Work. W.	(5) S.	(6) No of Students.
I. Architecture, ...	18	84	76½	62	94½	111	258
II. Civil Engineering, ...	14	60	76½	72	59½	70	278
III. Mechanical Engineering, ...	16	63	91½	83	66½	80	500
IV. Electrical Engineering, ...	23	70	81½	72	78½	86	311
IV. Technical Chemistry, ...		47	48½	40	124½	137	121
IV. Electro-Chemistry, ...		56	51½	40	126½	101	
V. General Science, ...	16	48	49 +	48 +	27 +	35 +	82

\+ Additional hours not enumerated.
(W.—Winter Semester. S.—Summer Semester or Term.)

with the night and day shift system, which prevails in many departments of our Technical College; and with the same *students* as well as teachers attending both shifts, it would be utterly impossible to overtake more than a mere fraction of the work done in the German Schools.

VI. THE AIM OF THE INSTRUCTION.

As defined for example by the statute of the Kingdom of Saxony, the Aim is to give a complete training in Science and Art to those who are to be engaged in Technical Pursuits, including teachers of various branches of Science, *e.g.*, Mathematics, Physics, and Chemistry. The Prussian statute is fuller in one important par-

TABLE II.—*The Royal Technical High School at Berlin (Charlottenburg.)*

SESSION 1898-1899.

(1) SECTIONS.	(2) Teachers.	(3) Courses.	(4) Weekly Teaching Hours. Lectures. W.	(4) Lectures. S.	(5) Prac. Work. W.	(5) Prac. Work. S.	(6) No. of Students. Winter. Stds.	Winter. Hospitants.	Winter. Totals.	(7) Summer. Stds.	Summer. Hospitants.	Summer. Totals.
I. Architecture, ...	38	88	45½	41½	119	132	366	264	630	389	236	625
II. Civil Engineering, ...	23	61	78	69	56	60	450	31	481	474	30	504
III. Mechanical Engineering (including Electrical Engineering), ...	39	101	93	83	113	139	1150	279	1429	1062	241	1303
IV. Marine Engineering and Naval Architecture, ...	6	41	44	38	48	40	213	33	246	195	29	224
V. { Chemistry and Metallurgy, ...	41	55 45	80	68	309	313	243	35	278	215	29	244
VI. General Science, ...	38	46	142	145	52	50	3	5	8	2	4	6

ticular, which has been the subject of much discussion in Germany, viz., the relative academic position of the Technical High Schools and the Universities. The statute runs that the aim is "to give the highest training for Technical callings in the service of the State, the Community and in Industrial Life, also to foster those Arts and Sciences which bear upon Technical Instruction."

TABLE III.—*The Royal Technical High School, Dresden, Saxony.*
SESSION 1898-1899.

(1) SECTION.	(2) Teachers.	(3) Courses.	(4) Instruction. Weekly Hours. Lectures. W.	Lectures. S.	(5) Exercises and Prac. Work. W.	Exercises and Prac. Work. S.	(6 & 7) No. of Students. W.	No. of Students. S.
I. Architecture, ...	20	91	76	78	109	111	128	145
II. Civil Engineering—								
(a) Constructive Engineers,	24	68	80	83½	52	83	219	242
(b) Surveyors, ...		45	44½	44	28	33		
III. Mechanical Engineering—								
(a) Mechanical Engineers,	20	67	80	87	67	71	302	341
(b) Electrical Engineers, ...		68	80	87	69	69		
IV. Chemistry—								
(a) Technical Chemists, ...	20	52	27+	29+	83+	59+	140	147
(b) Works Engineers, ...		32	34+	30+	22+	22+		
V. General Section—								
(a) Mathematics, ...	13	38	92		36		30	36
(b) Natural Science, ...	11	15						

\+ Additional hours, not enumerated.

In the rectorial address delivered at Charlottenburg last year, Dr. Riedler set himself to rebut the charge of strict "professionalism" made against the Technical Schools by the Universities. He pointed out (1) that in his own section of Mechanical Engineering for example 78% of a student's work in his first year is of a general scientific nature, 50% in his second year, 25% in his third. It is therefore only in his fourth or last year that a

students work is entirely professional; (2) that such subjects as Physics, Mechanics, Thermodynamics, and Electromechanics are studied to far greater "depth" at the Technical Schools than at the Universities; and (3) that great gaps in our knowledge of these subjects as well as in the Strength and Elasticity of Materials and in Hydraulics have had to be filled up at the Technical Schools. He also instanced the development of Graphical Methods as another direction in which their work had been greatly extended by themselves. As regards the entrance status of students, Dr. Riedler, found that in Berlin-Charlottenburg the advantage lay with the Technical School rather than with the University. Taking the Philosophical Faculty as the most unprofessional section of the latter, he found that in it in the winter semester of 1898, no less than 30% of the students attending had not got the "Reifezeugniss" or certificate of ripeness, while over the whole Technical High School the percentage without it was only 13.

But in one important respect the Rector admits that the School is at a disadvantage as compared with the University, and that is as regards the numbers on the Teaching Staff. Coming after what has been already stated and shown in column 2, Tables I. to V., regarding the enormous disparity of their numbers and ours, this sounds almost comical to us. But the comparison made between School and University shows that the complaint is well founded. Thus in the Faculty of Law in Berlin University, with extremely simple teaching arrangements, there are 26 professors for 2,072 students, while in the Faculty of Medicine with arrangements more like those required in a Technical High School, there are 21 ordinary professors, 33 extraordinary professors, and 84 other teachers for 1,238 students. There are also 33 Institutes in connection with this Faculty, requiring in addition to the staff already mentioned, 75 assistants. Certainly beside the 21 ordinary professors of the Medical School, the 7 ordinary professors of the Mechanical Engineering Section in the Technical School, with 200 more students, look very small. But not much time has been lost. The present disparity is no doubt caused by the phenomenally rapid increase in the number of students attending the Technical High Schools. In 1884 the total for all sections at Charlottenburg was 887. Last session this had risen to 3,428, the Mechanical Engineering alone having a total of 1,429. (See also Table X., page 94.)

The Training in the various courses in these Colleges covers about 10 months of the year, with the exception of a

TABLE IV.—*The Grand Ducal Technical High School at Karlsruhe, Baden.*

(1) SECTION.	Session 1899 1900. (2) Teachers.	(3) Courses.	(4) Weekly Hours. Instruction. Lectures. W.	Lectures. S.	(5) Prac. Work. W.	Prac. Work. S.	Session 1898 99. (6) Winter. Students.	Winter. Hospitants.	Winter. Totals	(7) Summer. Students.	Summer. Hospitants.	Summer. Totals.
I. General Section— (*a*) Mathematics, ... (*b*) General Subjects, ...	17	51	59	56	31½	33½	7	2	9	7	6	13
II. Architecture, ...	14	55	32	32	107	136	151	33	184	146	16	163
III. Civil Engineering, ...	9	38	35	25	39	48	146	6	152	153	4	157
IV. Mechanical Engineering, ...	6	29	26	30	50	49	278	20	298	250	11	261
V. Electrical Engineering, ...	8	30	34	33	27	25	156	12	168	156	9	165
VI. Chemistry— (*a*) Technical Chemistry, ... (*b*) Foodstuffs, ... (*c*) Pharmacy, ...	15	61	46	42	40	36	129	11	140	128	13	141
VII. Forestry, ...	7	27	29	30	6	8	27	1	28	16	—	16

fortnight off at Christmas and the same at Easter, and it may be summarized as consisting of Lectures, Repetitions, Exercises, Drawing and Designing, Instruction by means of Models, Graphical Work, Practical Work in Laboratories and in Workshops and Institutes for the Mechanical Testing of Materials, Excursions to Works in operation or in course of construction.

TABLE V.—*The Royal Technical High School at Stuttgart, Wurtemberg.*

(1) SECTION.	(2) Teachers.	(3) Courses.	(4) Instruction. Weekly Hours. Lectures. W.	(4) Lectures. S.	(5) Prac. Work. W.	(5) Prac. Work. S.	(6) No. of Students. W.	(7) No. of Students. S.
I. Architecture, ...	9	40	52	37	112	90	187	148
II. Civil Engineering, ...	12	43	70	56	65	70	128	105
III. Mechanical Engineering, ... including	22	45	75	56	52	42	313	259
Electrical Engineering, ...		51	79	60	58	74		
IV. Chemistry, ...	14	30	47	42	45	67	88	65
including Metallurgy, ...		30	62	36	42	57		
Pharmacy and Foodstuffs, ...		16	26	28	38	43		
V. Mathematics and	22	40	40	27	53	53	27	26
Natural Science, ...		31						
VI. General Section—								
(*a*) For Teachers of Real Schools, ...	17	39					24	20
(*b*) For the higher appointments in the Railway, Post and Telegraph Services, ...	11	11	28	17	14	6	4	4

The old style of dependence upon Lectures, which any intelligent student can read for himself and study out of a book, is being largely given up, in favour of a minimum of Lectures and a maximum of Exercises and Practical Work. The large proportion of time now given up to the latter may be seen from Tables I. to V., column 5. Thus in Table II., the summation of the weekly hours for all the sections and all the courses, winter and

summer at Charlottenburg, gives a total of 927 hours for Lectures and 1,431 for Exercises and Practical Work. As a particular example of the development of a section in this direction, I might instance two divisions of the curriculum in the Mechanical Engineering Department at the same College. In the General Science subjects (Mathematics, Mechanics and Physics), the Practical Work grew from 6 to 16 hours per week between 1881 and 1889. And in the same interval, the Practical Work in the Professional subjects extended from 20 to 48 hours per week, the Lecturing having come down from 32 to 22 in the one division and from 28 to 23 in the other, the remainder being deducted from the time formerly given to Architectural, Civil Engineering and Chemical subjects. Thus the change has been at one and the same time, concentrative and practical. In the one item of the teaching of Machine Construction alone there is a rise of from 9 hours to 32 per week, between 1881 and 1889 respectively and the growth of the Graphical Work all along the line of the General Sciences is no less noteworthy.*

VII. Entrants.

The steady and rapid rise in the number of students attending the various sections is now a well marked feature in all the Colleges, and the great preponderance of the regular diploma students over "Hospitants" and "Hearers" is specially significant. (See Tables VIII. and X.). Of 598 newly matriculated students entering Charlottenburg in Oct. 1898, 248 had the "Certificate of Ripeness" from *Gymnasien* (Appendix, Note A). 149 from *Realgymnasien*, 45 from *Oberrealschulen*, 71 from Secondary Schools of corresponding standing, *i.e.*, from Schools with 9 years' courses, outside of Germany, and only 85 from other Schools, such as *Realschulen* with a 7 years' course or from Höhere *Gewerbeschulen*, *i.e.*, Technical Schools of a middle rank. (Appendex, Note B). But at Stuttgart, where is placed the school for the little kingdom of Wurtemberg, the figures according to Table VII., are the other way about, *i.e.*, the majority of the students come from the Modern rather than from Classical

* These and many other particulars concerning the Charlottenburg Institution have been obtained from the very excellent historical "Chronik" of the school, a copy of which was most kindly sent to me by the Rector (Dr. Riedler) and Senate, for this paper, along with a set of plates with plans, elevations and sections, from which the lantern slides were made.—A. M'L.

Schools as at Berlin. Thus of 771 students attending during the winter term of 1898-99, 411 came from *Realschulen*, as against 321 from *Gymnasien*. And as regards status in studentship, it will be seen from Table VIII., that in all the Schools, the great majority of those attending are diploma students. Thus of 1,550 students attending the Technical High School of Hanover during session, 1899-1900, 1,140 were regular students, 282 were "Hospitants" taking up more or less of the full courses, and 128 were "Hearers"

TABLE VI.—*Entrance Qualifications of Students attending Hanover Technical High School, Session, 1898-99.*

NOTE.—The terms "with" and "without" mean *with* the "Reifezeugniss" or Certificate of Ripeness from the Secondary School attended, or *without* it.

From Secondary School.	Students.		Hospitants.		Hearers.		Totals.
	With	Without	With	Without	With	Without	
Gymnasia, ...	412	49	—	56	17	14	548
Real Gymnasia, ...	372	77	—	42	10	16	517
Upper Real Schools, ...	99	28	—	18	—	2	147
Real Schools (7 years), ...	8	—	—	—	—	—	8
,, (6 years), ...	—	—	—	57	—	5	62
Various Secondary Schools, ...	—	—	—	91	6	48	145
From Schools outside Germany,	—	95	—	18	—	10	123
Totals, ...	891	249	—	282	33	95	1550

taking up single courses. Table VI. shows that 1,065 of these were from *Gymnasien*, and 217 from *Realschulen*. The remainder came from various higher schools in and out of Germany.

VIII. LIBRARIES, MUSEUMS, COLLECTIONS.

As might be expected from the way in which a German College is staffed, the equipment is provided with a princely hand. In the Libraries, *e.g.*, one may see complete sets of English Patents going back for 60 or 70 years. Thus Aachen has about 250,000 specifications of English Patents on its shelves. Charlottenburg

began in its present new building in 1884 with 40,000 volumes. It has now 70,000 volumes. In one year in Dresden, 15,000 vols. and 130,000 specifications of Patents are made use of. Dresden and Munich each spend £500 a year on their books. In the Architectural section at Charlottenburg, there is a room of 1,750 sq. ft., occupied by Plaster Casts; 2ndly, the Callenbach collection of models of old and historically important Buildings in Germany, occupying 1,200 sq. ft.; 3rdly, there is the Beuth-Schinkel Museum

TABLE VII.—*Secondary Schools attended by Technical Students.*

SCHOOL.	Charlottenburg. Entrants only. October 1898		Stuttgart. Totals. Session 1898 99.		Hanover. Totals. 1899 00.
	W.	S.	W.	S.	
Gymnasia, ...	248	100	206	166	548
Real Gymnasia, ...	149	78	115	88	517
Real Schools, ...	45	19	411	342	217
Other Institutions, ...	71	14	39	31	268

TABLE VIII.—*Proportion of Regular Students to Hospitants, etc.*

Status.	Aachen. 1898 99.		Charlottenburg. 1898 99.		Dresden 1898 99.		Hanover. 1899 00.	Karlsruhe. 1898-99.		Stuttgart. 1893-99.	
	W.	S.	W.	S.	W.	S.		W.	S.	W.	S.
Students, ...	341	370	2425	2337	819	911	1140	894	857	771	627
Hospitants, ...	104	105	647	569		14	282	85	59	205	48
Hearers, ...	41	21	356	245	92	31	128	119	65		

of Drawings and Designs by great Architects, occuping over 2,200 sq. ft. In addition to this, floor space of about 1,100 sq. ft. is occupied with Models and Teaching Appliances connected with the instruction given in the section of Architecture. For the Engineering section there is, (1) a collection of models of Machine Elements of 1.350 sq. ft.; (2) a collection of models of Machines, 1,500 sq ft.; (3) a "Reuleaux" collection of Kinematic models of about 2,000 sq. ft.—hundreds of Working Models, illustrating every Mechanical movement of any scientific or

practical importance. The saving of time to both teachers and students is great, as the motions of the various points can be seen and followed without any desperate effort of the imagination as when left to that alone, but it must have taken many thonsands of pounds to put such a collection together. (4) A collection of models of Railway Machinery of 1,500 sq. ft. (5) A Shipbuilding collection of 3,000 sq. ft. (6) A Technological collection of 4,000 sq. ft. But it may be said again, all this is on an imperial scale. Well, I will turn once more for a few minutes to a smaller school, *e.g.*, that at Dresden, some particulars of which are given in Table III. This city may be compared to Edinburgh in size, but it is the capital of a smaller kingdom than Scotland, with a population under 4,000,000. Yet the collections in the Main Building (MB, Fig. 12, also Figs. 9, 10, 11) of the Technical High School have close on 12,000 sq. ft. of floorage, and this is exclusive of the Chemical collection, which is in a separate building. (I. Fig. 12.)

All sections are generally well provided for. Thus, *e.g.*, Brunswick with only 362 students has 23 separate collections, among which are those for Geometric Models, for Physics, for Geodesy, for Mechanical Technology, for Electrotechnics, for Inorganic, Organic and Technical Chemistry, for Pharmacy, for Public Health, for Mineralogy and Zoology. The Library, Museum and Aula occupy 18,000 sq. ft. At Aachen, they have a great wealth of all kinds of Instruments used in Surveying, Levelling and in Mining.

IX. SECTIONAL ACCOMMODATION.

In this connection I have found the case of the Brunswick Technical High School very interesting from having had before me the Report of the Architects (kindly sent to me, along with much valuable literature on German Technical Schools by the Rector, Dr. Beckurts). The building, which was opened in 1877, was designed for 450 students, distributed as in Table IX., col. 2, with the exception of 20 students in Forestry, not included in the Table. On comparing these numbers with the plans, they are found to work out at the figures given in column 4 of the Table. The Architects say that in particular the Chemists demanded ("Viel Platz, viel Licht, viel Luft,") plenty of room, lots of light, and as much fresh air as possible, as they spent most of their lives in their Laboratories. They seem to have got room, as the whole of the back or east side of the building is occupied by them, their

rooms and laboratories being arranged round four inner courts, with a total area of about 50,000 sq. ft., which works out at 410 sq. ft. per student of the estimate.

In the general distribution of the rooms throughout the building, it was planned to have the collections and laboratories as near as possible to the relative lecture rooms. The latter take the "long

TABLE IX.—*Sectional Accommodation in the Royal Technical High Schools at Hanover and Berlin.*

(1) SECTION.	(2) (3) (4) Brunswick designed for 450 Students.			(5) (6) (7) Berlin (Charlottenburg) designed for 2,000 Students.		
	No. of Students in Estimate.	Total Area in Sq. Ft.	Area in Sq. Ft. per Student.	No. of Students 1895-96.	Total Area in Sq. Ft.	Area in Sq. Ft. per Student.
Architecture, ...	150	29,113	194	341	51,000 (6,628)*	150
Civil Engineering, ...				433	15 214 (3,314)	35
Mechanical Engineering,	100	27,584	275	915	4,8634 (9 523)	53†
Naval Architecture and Marine Engineering,	—	—	—	148	16,730 (6,219)	111
Chemical Technology and Pharmacy, ...	120	49,270	410	—	—	—
Do. and Metallurgy, ...	—	—	—	144	61,352	426
General, ...	60	11,556	192	—	6,380	—

* The figures in brackets refers to lecture rooms used in common.

† The extension building will add 60,000 sq. ft., making a total of 108,634, which gives 76 sq. ft. per student attending the section last year.

Total cost, Brunswick, £105 512; Rate per Student, £235.

Total cost, Charlottenburg, £390,516; Rate per Student, £195.

formation" to bring the classes in front of the lecture table and avoid obliqueness of view of diagrams and blackboard sketches. The Chemical Auditorium is seated for 154 at the rate of 11.2 sq. ft. per student.

Charlottenburg is another such case in point. It was designed for 2,000 students, and was opened in 1884. I have not met with the details of the estimate as in the case of Brunswick, but it so happens that in the winter semester of 1895-96 the actual numbers

attending came very close upon the estimated total, being 1,982. Taking the attendance therefore in each section during that session as a basis, the accommodation provided is at the rates shown in Table IX., col. 7. The Mechanical Engineering section has grown tremendously. In 1884, the numbers were 275/887 or 31% of the whole number of students attending, but last year they had mounted up to 1,429/3,428 or 41°/₀ of the whole. A large new building is therefore in process of erection which will add about 60,000 sq. ft., to the accommodation for this section. The design (Figs 3 and 4) provides 14 Drawing Rooms (DR) for 700 students at the rate of 31 sq. ft. for each, not including the space for Drawing Boards, etc. along the corridor side of each room; 12 Rooms for collections (C) with a total floorage of 12,374 sq. ft.; 2 Lecture Rooms for 400 and 150 respectively, at the rate of 9 sq. ft. per hearer. The Great Lecture Room (LLR) is 74 ft. by 48 ft., and the largest Drawing Room has 70 places.

The Mathematical and General Science section in the main building has 6,380 sq. ft. assigned to it. As yet the numbers attending for that section *alone* are very small, but the number of students who come out of the other sections for their Mathematics and Physics, Descriptive Geometry and Graphic Statics, Political Economy and Science of Finance, Industrial Hygiene and Law, etc. must be very considerable. The same applies, of course, to the inter- and extra-sectional work in all the Departments, but exact numbers were not available for rating.

The totals and the rates which have been given are to be understood in all cases, as inclusive of everything,—Museums, Collections, Laboratories, Drawing Rooms, Lecture Rooms, and even the Corridors, which in many cases are elongated Museums or Collections, as well as passages. For a student is expected to fill up the gaps in his day, and the pauses in his work by inspection of the various materials and applications of them shown in these corridor cases. Secondly, the figures are to be understood as including in each case, the Lecture Rooms used in common by more than one Section. Vast as the Charlottenburg building is, the demands made upon some rooms latterly show that it has become too small. Thus for example, it may be found from the Time Table, that one room is used 33 hours per week for Lecturing, another for 28 hours and others 23, 21, etc.

The two cases cited above may be taken as samples of the whole, with the exception that at Charlottenburg, the Architectural

TABLE X. — *Statistics of Attendance at the Technical High Schools of Germany.*

SCHOOL.	1893-94.				1894-95.				1895-96.				1896-97.				Comparison with Table VIII.			
	Summer		Winter		Summer		Winter		Summer		Winter		Summer		Winter		1894-95.		1898-99.	
	Students	Hospitants	Students	Hospitants	Students	Hospitants	Students	Hospitants	Students	Hospitants	Students	Hospitants	Students	Hospitants	Students	Hospitants	Winter Totals	Summer Totals	Winter Totals	Summer Totals
Aachen, ...	185	99	209	86	209	96	213	92	223	93	234	119	234	98	258	104	295	305	486	496
Berlin, ...	1501	507	1752	653	1681	569	1903	729	1767	629	1982	753	1892	621	2182	826	2405	2250	3428	3151
Brunswick,	150	128	162	129	184	123	231	139	250	119	254	134	351	31	362	40				
Darmstadt,	438	76	500	77	536	61	648	95	698	72	765	105	850	104	1067	115				
Dresden, ...	359	109	381	213	459	135	425	245	469	145	507	225	599	163	594	262	594	594	993	956
Hanover, ...	449	180	487	240	513	183	549	265	574	202	607	303	625	199	674	180	727	996		1550
Karlsruhe, ...	634	47	753	128	721	97	754	147	709	125	757	159	690	116	798	198	881	818	1098	981
Munich, ...	773	359	929	398	937	380	1013	410	1012	347	1182	379	1158	361	1372	371				
Stuttgart, ...	356	37	518	215	438	40	570	188	493	36	624	202	516	47	655	253	733	478	976	675
Totals,	4845	1542	5691	2139	5678	1684	6306	2310	6195	1768	6912	2379	6915	1740	7908	2349				

and Chemical sections have been specially well provided for. So also will be the Mechanical Engineering section, when the new building is in working order. But some of the other places, do more, in proportion, for Electrotechnics. Thus at Karlsruhe, they have a fine building of which the plans of two floors are shown in Figs. 5 and 6, 135 ft. by 128 ft. entirely given up to that section. The building was designed for 100 workers, the total space (including walls, stairs and corridors) is about 45,000 sq. ft. or 450 sq. ft. per student. The cost was £27,600 or £276 per place. The building is a hollow square in plan and its position on the Ground Plan, (IX., Fig. 2) 328 ft. from the nearest street helps to keep it free from vibration and magnetic or electrical influences. On the first floor, Fig. 5 are the Laboratories, LB through which every student of the normal course must pass. In three rooms the first exercises or introduction to theoretical and practical Electricity are worked. In others the phenomena of Induction, Capacity and Magnetic Retentivity are studied. The general arrangement of the rooms is such as to be most convenient for the traffic. During the forenoon, in which no Laboratory work is done, the Lectures and Constructive Drawing Exercises confine the traffic to the upper floor. Fig. 6. In the afternoon the Laboratory work keeps the intercourse confined to the lower and sunk floors. The Machine Room, MR, Fig. 5 (Interior, Fig. 7) the Workshop, WS, the Store and the Switchboard Room SBR are all together, and the Gas Engine Room is immediately below. The Management Rooms —Directors' Room, Assistants' Room, Library, etc. are close by one another and there is Telephonic communication between these Rooms and the others mentioned. The principle upon which the individual rooms were shaped was that they should be constructed as little as possible for special measurements, so that the arrangements of to-day might not hamper those of to-morrow. The Laboratories are large and airy with a height of 15 ft. 6 ins. The Machine Room is 80 ft. by 34 ft. 6 ins. height 21 ft. There is an Electric Travelling Crane of 25 ft. span, and $2\frac{1}{2}$ tons capacity. When speaking of this College, it should also be mentioned that two years ago, Karlsruhe opened a fine new building (X, Fig. 2), 292 ft. long by 170 ft. broad, which cost over £40,000, mainly for Architectural and Graphical work, but one part of the building was wanted for a New Aula or Grand Hall, in commemoration of the 60th year of the College's existence. The rooms are grouped about two open courts, each 85 ft. by 82 ft. in size. There are

two floors in use, and on both the Drawing Rooms have all the north facing windows, and measure in all 450 ft. in length, with a uniform breath of 20 ft. Five of them have 30 tables in each. The tables are 3 ft. broad, the passages between and at end o the rows are 4 ft. wide, and the windows are 20 ft. high. In the Corridors, which are from 10 to 13 ft. wide, there are 140 numbered Lockers for the use of the students, and the walls are utilised for the display of diagrams and of all kinds of materials used in the departmental work as well as of models large and small. The Aula is 88 ft. long by 39 ft. broad by 39 ft. high and is beautifully decorated. This collection of buildings represents a very considerable expenditure for the higher technical instruction in a small state like Baden, less in size, though with about the same population as Wales. But not content with the foregoing, Karlsruhe is about to put up another fine new building, (XII, Fig 2), 192 ft. by 153 ft. for its Chemical Section of which the plan of one floor is shown in Fig. 8. It will thus be seen that in proportion to their resources, the smaller states are by no means behind Prussia in providing accommodation. A spirit of healthy emulation seems to pervade the whole Empire, and the principalities are evidently determined not to be left behind.

X. Laboratories.

As has already been referred to in connection with the teaching, Practical work has everywhere become a most important feature in the Engineering courses. The extension of Graphical work and of Laboratory work has gone hand in hand. The one has necessitated more drawing room accommodation, the other more workshops for becoming acquainted with the various processes in mechanical manipulation, and more Laboratories for experimental and testing purposes. The extension of the courses from 3 years to 4, the last year being almost entirely professional, and in some cases differentiated into sub-sections, such as (*a*) General Engineering, (*b*) Railway Engineering, (*c*) Electrical Engineering has also favoured this development of the practical side of the training. About £19,000 has been spent at Charlottenburg, on the experimental Mechanical Laboratory in building and equipment since 1895. To mention only the more important details, the large machinery hall is 183 ft. by 33 ft., and in it there are two large specially constructed experimental engines of 200 h.p. each, as well as several smaller steam engines

of 60, 50, 25 h.p., also pumps, blowers, and compressors specially constructed for study and a great number of smaller machines. Many of these have been given as presents to the college, *e.g.*, a water-motor and a blowing cylinder through Professor Riedler, who had previously given an installation worth about £6,000, a large watertube boiler by Borsig of Berlin, and a complete condensing portable engine by Wolf of Magdeburg-Buckau. Last session they were able to accommodate 250 students weekly at practical work in this laboratory.

The Royal Mechanical Testing Laboratory occupies a separate set of buildings within the grounds of the college. These have between 10,000 and 11,000 sq. ft. of ground floor space, and are fully provided with all kinds and sizes of machines for testing metals under every mode of straining action, as well as for repetition of loading. There is a 500 ton machine, a 100 ton Werder machine, a 50 ton Martens machine, two smaller machines and one drop test machine, as well as machines for repetition of loading and fatigue of materials. In this latter connection it was very interesting to see some of the original machines devised and constructed by Wöhler, for his epoch making experiments, which placed our factors of safety on something like a scientific basis for the first time. There are also machines for testing all kinds of building materials,—stones, bricks, limes, cements, etc., as well as for testing papers and oils. This Institution, which began in 1871, with two officials, has now a staff of 25 scientists, 22 technical assistants, 26 mechanics, and 9 clerks.

The Electrotechnics Laboratory in this section began when the College building was opened in 1884 with 23 students. Its progress may be best indicated by some of the grants for extensions. 30,000 marks for additional equipment in 1892. 102,000 more by 1895, 24,000 in 1896, 75,000 as gifts. Altogether 400,000 marks or £20,000 have been spent on the equipment of the laboratory up till 1896, which was the date of my visit.

XI. BUILDINGS IN GENERAL.

In closing I shall now say a few words on the buildings of these Technical Colleges in general. There may be said to be three plans, the hollow square, the hollow rectangle and the letter E. The first is represented at Brunswick, the second at Dresden and Charlottenburg, and the third at Aachen, Darmstadt, Karlsruhe, and Munich.

The hollow square is represented at Brunswick only. It has several drawbacks. The inner quadrangle, which is 180 ft. sq., is larger than is required for light; on the other hand, the subsidiary light courts at the back of the building are too small at 50 ft. by 40 ft., and the system of mid-corridors is not a satisfactory method of lighting long passages. One is therefore not surprised that the Brunswick general plan has not been followed in any of the later buildings. The total cost of the Brunswick building was £105,512 or at the rate of £234 per student of the estimate.

Dresden's hollow rectangle, with its three floors, its "between building," and its two inner square courts, each 85 ft. by 75 ft., makes, I think, the very most of the ground under cover, and there the corridors are arranged as far as possible round the inner courts (Figs. 9, 10, 11). And the manner in which it is proposed to utilise the remainder of the site (Fig. 12), is shown in the ground plan between the main building (MB) and the chemistry block (L) behind. The total cost of the Dresden building (1872-75) was £123,000 or about £125 per student of the present attendance which, however, is probably considerably over the number originally estimated for.* The total area is about 21,200 sq. yds.

The plan of the Dresden main building seems to have commended itself to the Berlin authorities when arranging for their new building, which was opened in 1884. There, they have five inner courts, on account of the enormous length of the building, which is 746 ft. long by 294 broad. The courts are about 76 ft. sq., which is perhaps just to the small side, for properly lighting up the corridors on the ground floor, although it seems sufficient for the lecture rooms which occupy the "between buildings," and are thus lighted from both sides. The same plan was adopted in the Chemical Institute in the adjoining block. The total cost

* The total area of the three floors in the main block is about 150,000 sq. ft. This is the College for the Higher Technical instruction for a kingdom about the size and importance of Scotland. Compare these figures with 27,600 sq. ft. of floorage in the Andersonian Buildings, and 20,000 sq. ft. in the Bath Street Buildings. Compare also the 21,200 sq. yds. of ground area set apart at Dresden with the modest 9,000 sq. yds., which I understand the Governors of our Technical College propose to acquire altogether, and it will be seen that measured in this way, the sum of £150,000 to be raised and spent will still leave the Scotsman a long way behind the Saxon. It may also be mentioned here, that this School gets £13,000 a year from the Saxon Government.

of the Charlottenburg Main Building and Chemical Institute was £390,516 or £195 per student of the estimate.

The original building at Karlsruhe is an example of the letter E style of main building, but the general ground plan (Fig. 2) is also an epitome of the whole. The plan shews the stone and lime evolution of a Technical High School. First, you have the main building of date 1836 (I), then you have the 2nd stage of the process, when the Chemists and Metallurgists, with their fumes and smells and danger of fire are put out of the main building into one behind in 1851 (II); 3rd, an addition is made to the main building in 1852 (III); 4th, the Mechanical Engineering Section, which in Redtenbacher's time had outgrown its accommodation, was housed in a new building of its own in 1859 (V); 5th, there was another extension of the main building, this time for the Mathematics and Physics in 1864 (VI); 6th, a new building for chemical technology in 1881 (VIII); 7th, an Electrotechnics building in 1897 (IX); 8th, a new building for an Aula, and with additional accommodation for Architectural and Graphical work (X); and lastly, a new building for chemistry to be opened next year (XIII).

In conclusion exigences of time and space have only permitted me to touch very incidentally on some important matters, such as Administration, Teaching Staff, Entrance Certificates, and Degrees, and there are some other matters, for example, Rules and Regulations, Exams., Certificates, Bursaries, Insurance and Fees that have not even been referred to at all. But I think, at least I hope, that on the main question enough has been said to show how far we are behind in Glasgow, and to justify an expression of opinion, that voluntary effort *alone* is quite inadequate to the task of Erecting, Equiping, and Staffing Colleges on the scale necessary to enable this country to hold its own with Germany, in the matter of the Higher Technical Instruction. There, Governments, men of wealth, men of science and learning, inventors, manufacturers, merchants, and people have united in a mighty effort, which can only be met successfully, in my opinion, by a similar combination, co-operation, and co-ordination over here.

APPENDIX.

Note A, Secondary Education.

The system of Secondary Education in Prussia is constituted in three groups according as Latin and Greek, Latin only, or Modern Languages are made characteristic features of the Teaching. In all three groups, the following subjects are common—Religion, Mother Tongue, including narration of national events, French, History and Geography, Arithmetic and Mathematics; Physics, Chemistry and Mineralogy; Writing and Drawing. The Groups are—

I. With Latin and Greek—
Gymnasialanstalten (Classical Schools)—
(*a*) Gymnasien—a nine years' course.
(*b*) Progymnasien—a six years' course,

II. With Latin but no Greek—
Reallehranstalten (Modern Schools)—
(*a*) Realgymnasien—a nine years' course.
(*b*) Realprogymnasien—a six years' course.

III. With neither Latin nor Greek, but with English and more attention to Mathematics and natural science—
Reallehranstalten (Real Schools)—
(*a*) Oberrealschulen—with a nine years' course.
(*b*) Realschulen—with a six years' course.

Note B, Technical Schools.

Lower.

I. (*a*) "Lehrwerkstätten," Teaching Workshops or Apprenticeship Schools, in which practical instruction only is given.
(*b*) "Gewerbeschulen," "Baugewerkschulen"—in which theoretical instruction only is given, (see Note C II.)
(*c*) "Fachschulen," in which both theoretical and practical instruction are given in certain branches of industry.

Middle.

II. A middle grade or class of Technical Schools, which includes—
(*a*) Techniken, (see II. Note C).
(*b*) Industrieschulen, and
(*c*) Höheregewerbeschulen.

HIGHER.

III. The Technical High Schools or Science Universities described in the paper.

NOTE C.—THE TECHNICAL SCHOOLS OF HAMBURG ARE FAIRLY REPRESENTATIVE—

I. Baugewerkschule: II. Technikum—(*a*) Machine Construction School, (*b*) Marine Engineering School, (*c*) Shipbuilding School, (*d*) Electrical Engineering School: III. Carriage Building School: IV. Art Trade School: V. Day Trade School: VI. Evening aud Sunday Trade Schools: VII. Commercial Continuation Schools.

FIG. 2.—GROUND PLAN OF THE GRAND DUCAL TECHNICAL HIGH SCHOOL AT KARLSRUHE.

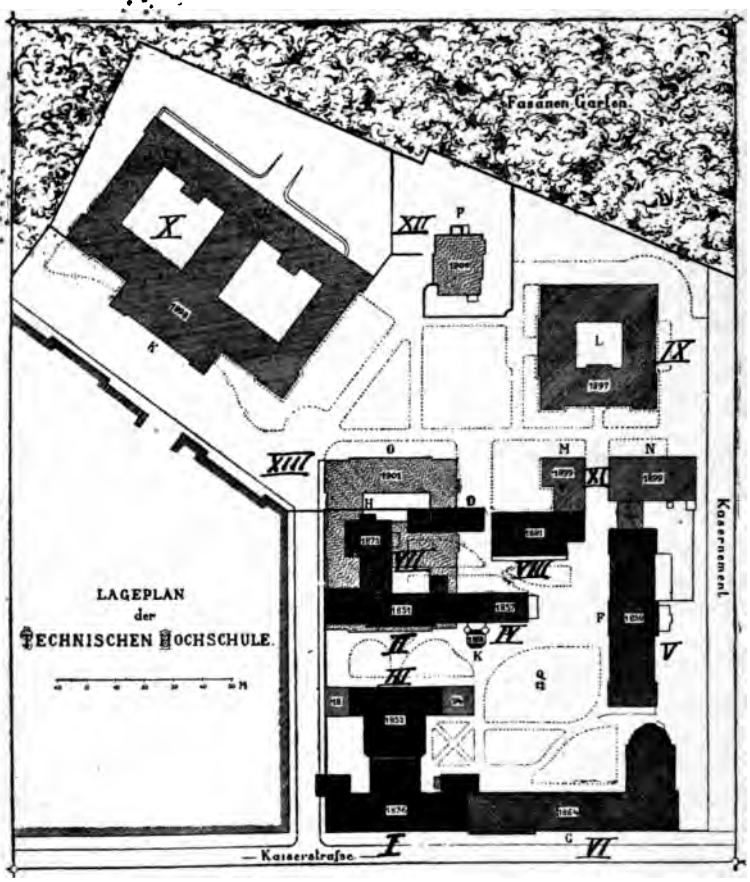


FIG. 2.

I.—The Original Main Building, 1836.
II.—Separate Chemical Laboratory, 1851.
III.—Extension of Main Building to back, 1852.
IV.—Extension of the Chemical Laboratory, 1857.
V.—Separate Building for Mechanical Engineering, 1859.
VI.—Extension of Main Building for Physical Cabinets, etc., 1864.
VII.—House for Director of Chemical Department, 1875.
VIII.—Extension of Chemical and Mechanical Technology, 1881; for Chemical Technology exclusively, 1893.
IX.—New Building for Electrotechnics, 1897.
X.—New Building for General Hall, Graphics, Architecture, etc., 1898.
XI.—Extension for Chemical Technology, Electric Light Installation, and Mechanical Laboratory, 1899.
XII.—House for Rector, 1900.
XIII.—Reconstruction; New Building for Chemical Section, 1901.

FIGS. 3, 4.—PLANS OF TWO FLOORS OF EXTENSION BUILDING AT CHARLOTTENBURG FOR THE MECHANICAL ENGINEERING SECTION.

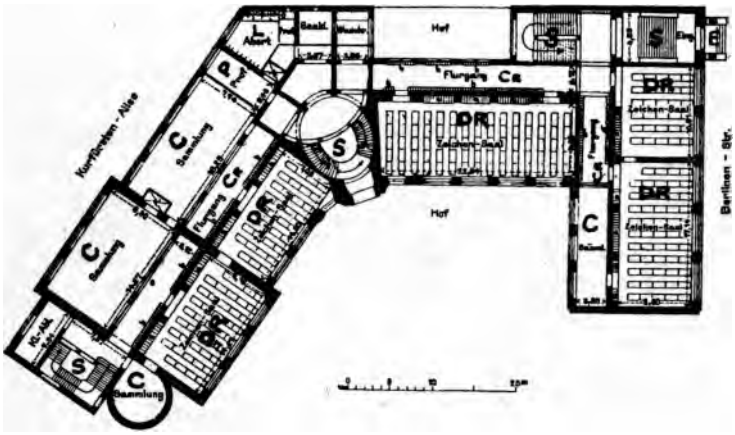


FIG. 3.

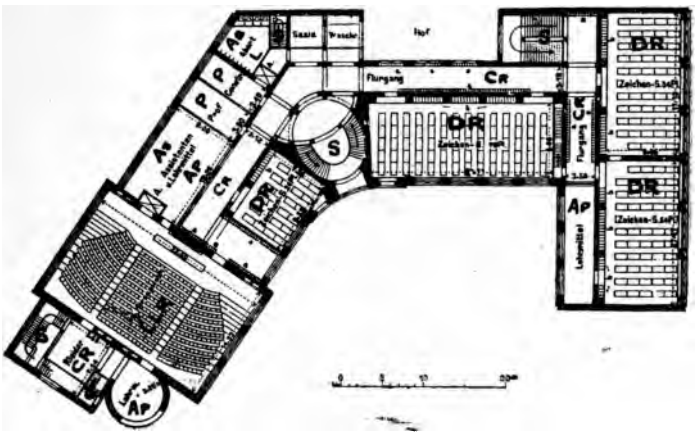


FIG. 4.

LLR.—Large Lecture Room, seated for 400.
DR.—Drawing Rooms, for 700 Students.
CR.—Corridors.
S.—Stairs.
CR.—Cloak Room.
L.—Lavatories.
C.—Collections (Museum).
AP.—Apparatus and Teaching Appliances.
P.—Professors' Rooms.
As.—Assistants' Rooms.

G. 5.—PLAN OF GROUND FLOOR OF THE NEW ELECTRO-TECHNICS BUILDING AT KARLSRUHE.

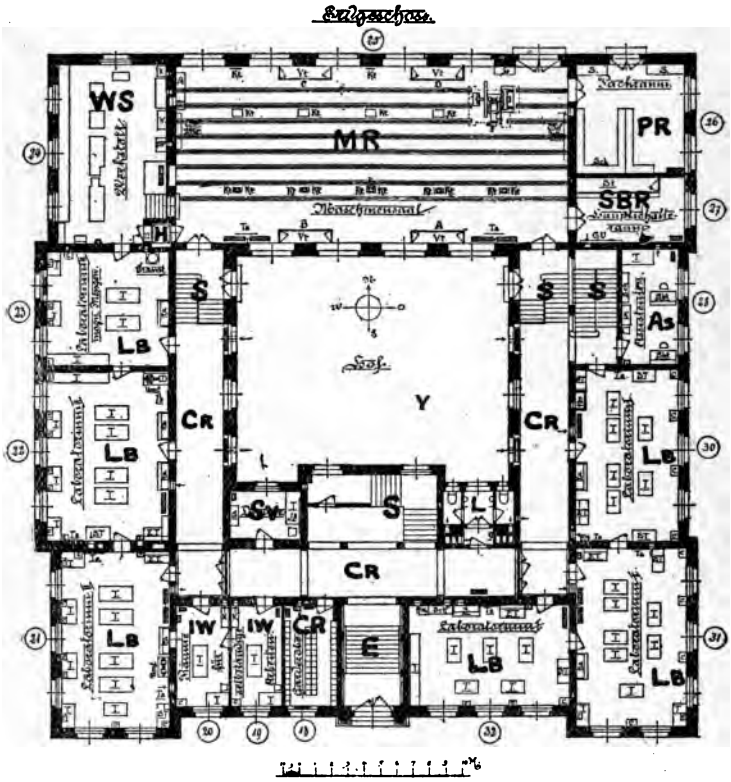


FIG. 5.

Y.—Inner Court.
MR.—Machine Room.
LB.—Laboratories.
WS.—Workshop.
IW.—Rooms for Independent Work.
PR.—Preparation Room.
SBR.—Principal Switch Board Room.
As.—Assistants' Room.
E.—Entrance Hall.
S.—Stairs.
CR.—Corridors.
CR.—Cloak Room.
L.—Lavatory.
H.—Hoist.
Sv.—Servants' Room.

FIG. 6.—PLAN OF UPPER FLOOR, NEW ELECTROTECHNICS BUILDING, KARLSRUHE.

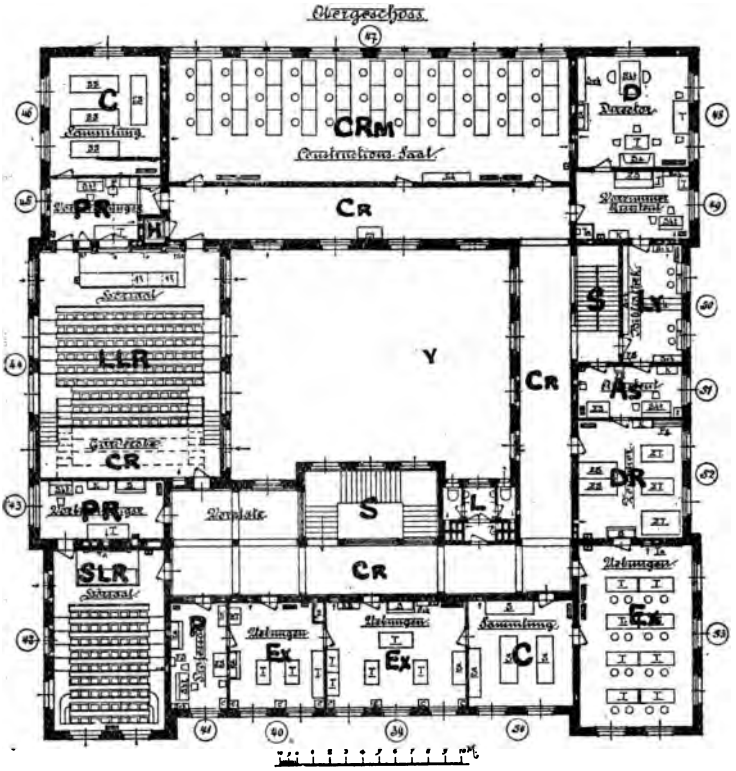


FIG. 6.

CRM.—Drawing Room (Construction).
C.—Collections (Museum).
LLR, SLR.—Larger and Smaller Lecture Rooms.
PR.—Preparation Room.
D.—Director's Room.
P.—Professor's Room.
EX.—Exercises.
LY.—Library.
DR.—Drawing Room (Design).

Other references as in Fig. 5 (Ground Floor).

FIG. 7.—THE MACHINE ROOM IN THE ELECTROTECHNICS BUILDING, KARLSRUHE.

FIG. 7.

The room is 80′ 0″ × 34′ 6″ × 21′ 0″ high, divided into two unequal bays by cast-iron columns. Machines can be fixed anywhere to I beams set pairwise longitudinally, and bedded on strong felt slabs, which prevent transference of vibration. The only fixing is a 7 K.W. Körting Gas Engine and Dynamo, seen at the upper end of the room. Overhead is a 2½-ton Electric Crane of 25 ft. span. (See also MR, Fig. 5.)

FIG. 8.—GROUND FLOOR OF THE NEW BUILDING FOR THE CHEMICAL SECTION, KARLSRUHE.

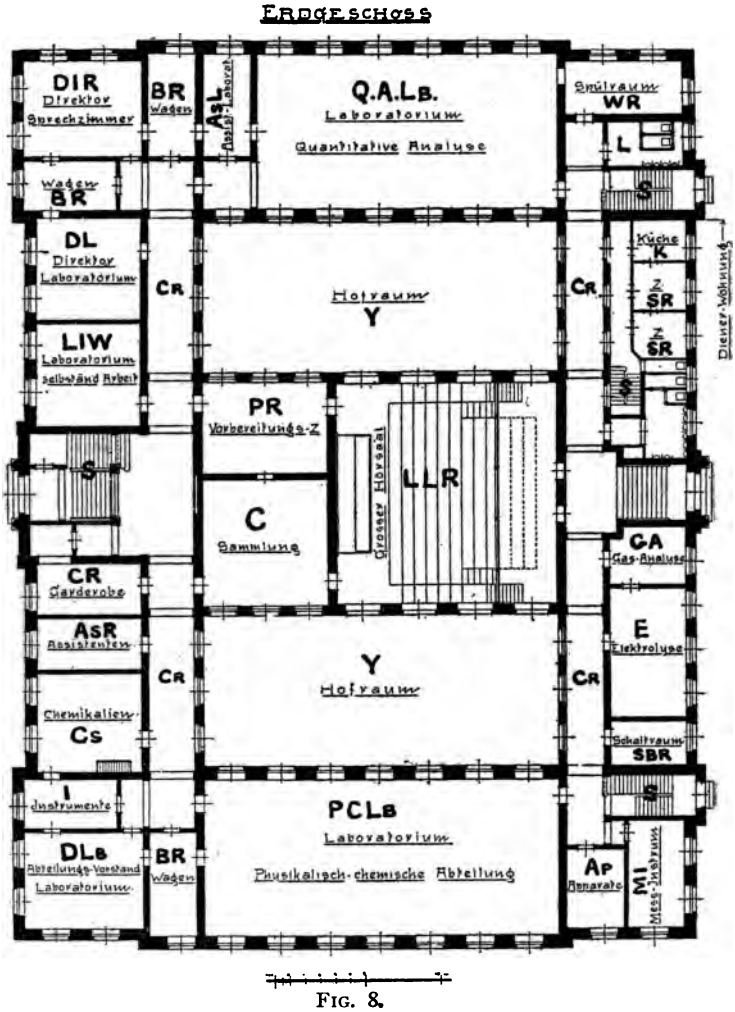


FIG. 8.

QALB.—Laboratory for Quantitative Analysis.
PCLB.—Laboratory for Physical Chemistry.
LLR.—Larger Lecture Room.
PR.—Preparation Room.
C.—Collection (Museum).
Y.—Inner Courts.
DL, DLB, AsL.—Private Laboratories for Director, Professors, & Assistants.
BR.—Balance Rooms.
I.—Instruments.
MI.—Measuring Instruments.
AP.—Apparatus.
Cs.—Chemicals. CR.—Cloak Room.
LIW.—Laboratory for Independent Work.
GA.—Gas Analysis.
E.—Electrolysis.
SBR.—Switch Board Room.
DIR.—Director's Interview Room.
K, SR.—Kitchen and Servants' Rooms.
CR.—Corridors.
S.—Stairs.
WR.—Wash Room.
L.—Lavatory.

FIGS. 9, 10, 11.—PLANS OF THE GROUND, FIRST AND SECOND FLOORS OF THE MAIN BUILDING OF THE ROYAL TECHNICAL HIGH SCHOOL, DRESDEN.

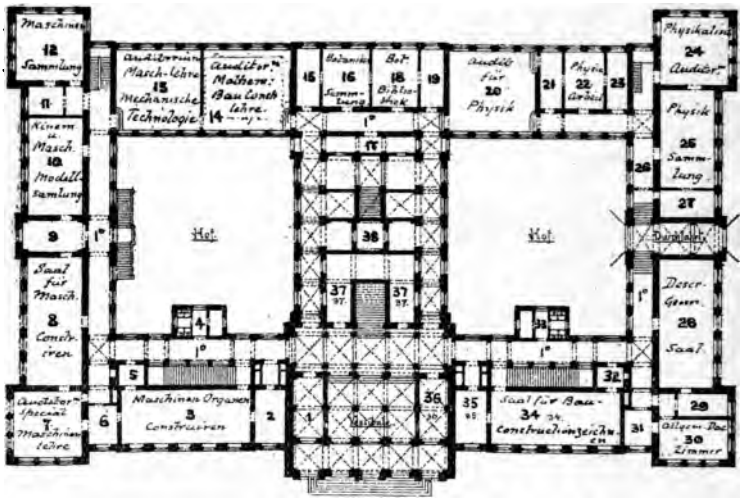


FIG. 9.

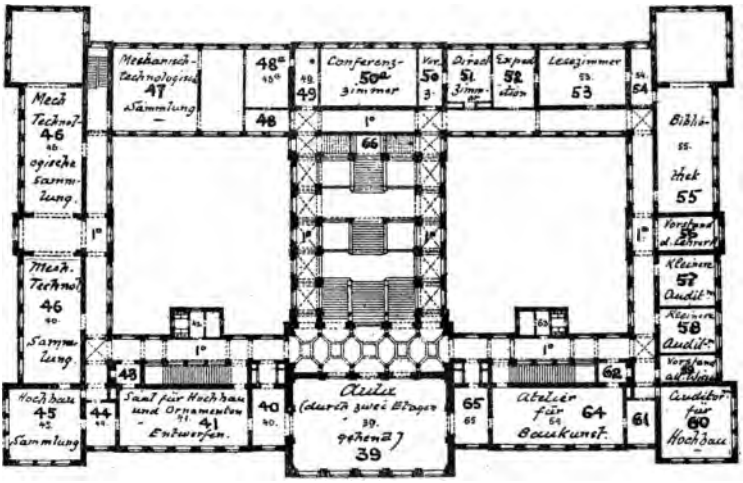


FIG. 10.

1°.—Corridors.
1.—Janitor's Room.
2, 6, 11, 23, 29, 35, 40, 44, 56, 59, 61, 65, 71, 74, 84, 87a, 89.—Professors' Rooms.
3.—Mechanism Construction Room.
4, 33, 42, 63, 69, 91.—Closets.
5, 32, 38, 43, 62, 70, 90.—Utensils.
7.—Lecture Room, Special Theory of Machines.
8.—Machine Construction, Drawing.
10.—Kinematic and Machine Models.

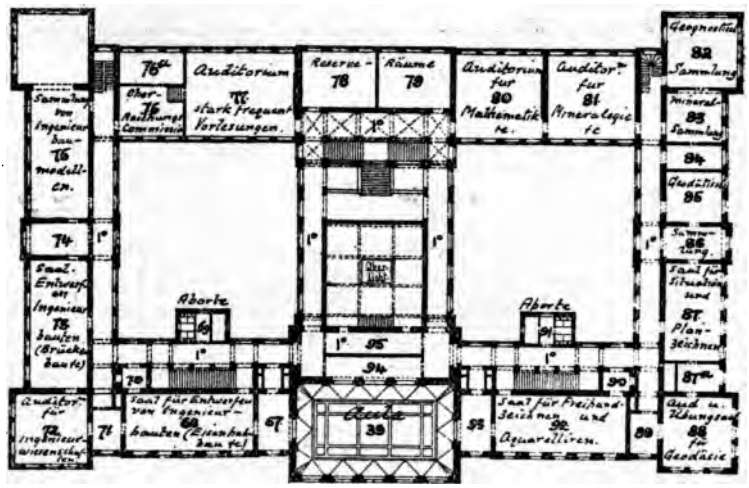


FIG. 11.

12.—Mechanical Collection (Museum).
13.—Lecture Room, General Theory of Machines, Mechanical Technology.
14.—Lecture Room, Mathematics, Theoretical Building Construction.
15.—Lecture Room, Political Economy.
16.—Botanical Collection.
17.—Store.
18.—Botanical Library.
19, 27, 78, 79.—Reserve Rooms.
20, 24.—Lecture Rooms for Physics.
21.—Dark Room.
22.—Small Lecture Room and Work Room for Physics.
25, 26.—Physics Collection and Cabinet.
28.—Drawing Room, P. P. and S. Geometry.
30.—Teachers' Room, General.
31.—Anteroom.
34.—Building Construction, Drawing.
36.—House Inspector.
37.—Cloak Room.
39.—Aula, (General Hall.)
41.—Architecture and Ornamental Design.
45.—Architectural Museum.
46, 47.—Museum of Mechanical Technology.
48.—Secretary's Room.
48a.—Council Room.
49.—Treasury,
50, 50a.—Conference Room, Anteroom.
51.—Directors' Room.
52.—Office.
53.—Reading Room.
54.—Librarian's Room.
55.—Library.
57, 58, 77.—Lecture Rooms, Various.
64.—Atelier, Architecture.
66.—Clock Chamber.
68, 73.—Drawing and Designing, Civil Engineering.
72.—Lecture Room, Engineering.
75.—Museum, Civil Engineering.
76, 76a.—Commissioners' Rooms.
80.—Lecture Room, Mathematics.
81.—Lecture Room, Mineralogy.
82.—Museum, Geology.
83.—Museum, Mineralogy.
85, 86.—Museum, Geodesy.
87.—Drawing Room, Buildings.
88.—Lecture and Work Room, Geodesy.
92.—Freehand Drawing and Water Colouring.
93, 94.—Orchestral Chamber and Side Room.

FIG. 12.—GROUND PLAN OF THE ROYAL TECHNICAL HIGH SCHOOL, DRESDEN.

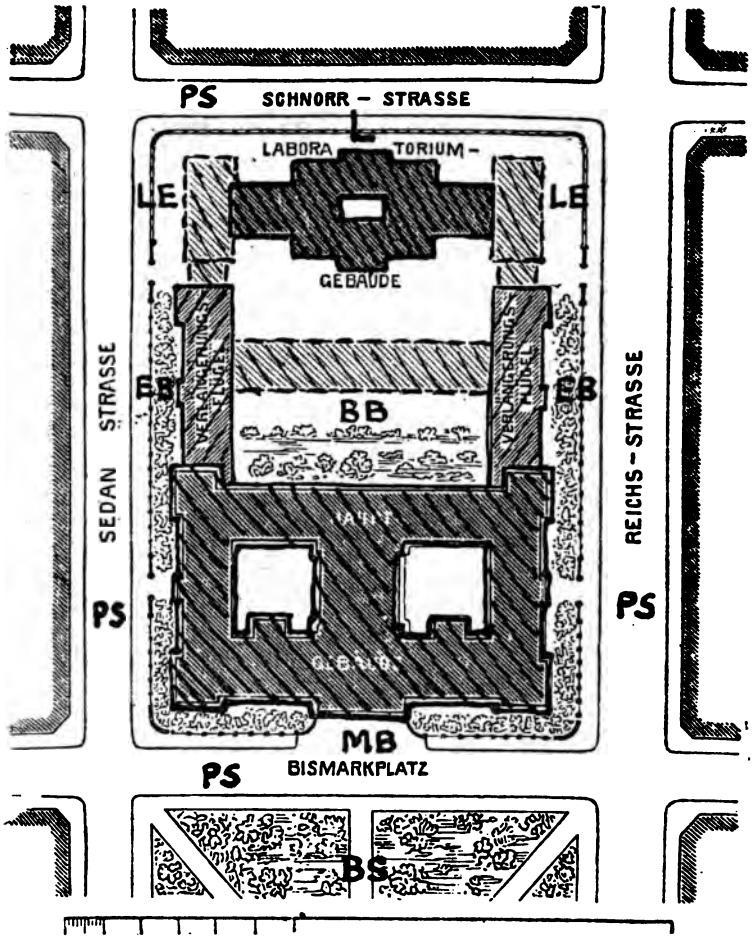


FIG. 12.

MB.—Main Building (the darkest shaded areas were built in 1875).

L.—Chemical Institute.

EB.—Side Extensions of Main Building, when required.

LE.—Side Extensions of Chemical Institute, when required.

BB.—Further Extensions of Main Building, if required.

BS.—Bismarck Square.

PS.—Public Streets.

Total Ground Area—21,200 sq. yds.

VIII.—*Sir Hew of Eglintoun and Huchown off the Awle Ryale: a Biographical Calendar and Literary Estimate.* By GEORGE NEILSON.

[Read before the Society, 6th February, 1901.]

I.—THE PERSONAL PROBLEM.

A GREAT problem of poetic identity was left for posterity to solve when about the year 1420, while James I. was still a prisoner in England, the chronicler Andrew of Wyntoun wrote:

> Huchown off the Awle Ryale,
> In till his Gest Hystoryalle
> Cauld Lucius Hiberius Empryoure,
> Quhen Kyng off Brettane was Arthoure.
>
> *Bk. v., line* 4301.

And the problem of the personality of the poet is only secondary to a still more important question—the identification of his works. One proposition appears to be universally accepted, viz., that Huchown's *Gest Hystoryalle* was the alliterative poem *Morte Arthure* as we now have it, allowance being made for a very small percentage of scribal change. The position of that poem strikes different critics in very various fashion, and as the views, which twelve months of close study have commended to me, place the author on a platform far loftier than has hitherto been accorded to him, it is desirable to begin with an examination of the grounds on which, for close upon a century, literary antiquaries, both English and Scottish, have reckoned Huchown a Scot, and have in general regarded him as one and the same person with the good Sir Hew of Eglintoun mourned by Dunbar in his poetical Lament.

Friends of Huchown, foes of Sir Hew, partisans of Scotland, and English gainsayers alike, may welcome as a much-needed preliminary an abstract and brief chronicle from public records and family archives of the external facts touching the career of the Ayrshire knight, round whom there now gathers so keen a controversy. It is no idle debate this struggle for the body of a dead poet, for by the assent of all critics the alliterative poems

involved contain work of supreme distinction, wide knowledge of medieval literature, and great power of language and form. The following Calendar of Events in the life of Sir Hew has been somewhat hastily drawn up with the object of providing exact references to the original sources; it neither pretends to completeness nor to such systematic arrangement as would clearly illustrate the life of Sir Hew in relation to his time. Nevertheless, the few brief annotations between the entries may serve the purpose of establishing some sort of sequence and connection among them, whereby the bearing of certain of the facts may be discerned. In the twelfth century a settler named Eglin or Eglun, mentioned in the records of the burgh of Irvine, had possessed and given name to the estate of Eglintoun, which lay adjacent in that part of Ayrshire. Bryce, Hugo, and Rodolph appear as owners subsequently, the last being on record in a transaction with the community of Irvine in 1205. Nearly a century passes, and then amongst the signatories to the Ragman Roll in 1296 appears the name of Raulf d'Egglinton whose seal, with the device of a hare in her form, or rabbit feeding amid foliage, carried the inscription Sigillum Radulfi de Eglintun. (Palgrave's *Documents* i., 171, Bain's *Calendar* ii., No. 776, also pp. 194, 205, 549). In August, of the same year, Rauf de Eglynton acts along with Adam de la More and William de la More on a jury of Ayrshire landowners, who, sitting at Berwick, found that young Sir Alan la Zuche was next heir to Dame Elena la Zuche in one third of the half part of Irvine. (Bain's *Calendar* ii., No. 824, article 6). The great cleavage of the war of independence was beginning. The Zouche family, descended by the mother's side from the Scottish house of De Quency, soon ceased to hold their Scottish lands. The Mores (from Rowallan, it is understood) rose to distinction in the person of Reginald who was to become Chamberlain of Scotland, and whose daughter Sir Hew of Eglintoun was one day to marry. Of Rauf of Eglintoun, who was apparently not a Knight, practically nothing is written unless it be that he received a letter in the summer of 1297 from Edward I., requiring him to assist Hugo de Cressingham, then about to start on the disastrous march which was to halt somewhat sharply at Stirling Bridge (Stevenson's *Historical Documents* ii., 167-9). After this comes an utter silence of five and forty years, in which no word makes itself heard of Rauf or his family. No data exist to make us secure in speculating whether our Hugo was the son

or the grandson of Rauf. What side Rauf took, where he lived, whom he married, where he died, where the young Hugo was born and reared—all this is unknown. Our Eglintoun calendar is a blank for many years. There is reason to believe that two of the sons of Reginald More (who had a special connection[1] with the monastery of Sempringham in Lincolnshire, and with the Order of Knights Hospitallers in this country) were educated in England. At any rate these two future brothers-in-law of Hugo received in 1333 safe conduct[2] for five years' residence in England. No such gleam of early record brings light to the mystery of Hugo's childhood and youth. Not till 1342 is the silence broken. To the great joy of Scotland, King David Bruce had returned from France. Full of youthful chivalrous energy, he invaded England three times in the year 1342. If in the second of these expeditions he was rather unlucky, we at least are fortunate in making, through his army's mishap, our first acquaintance with Hugo of Eglintoun. A number of young knights had been created who rode with their king, as Wyntoun tells us, "to wyn thare schone," but fate was adverse, and five of them, Stewart, Eglintoun, Craigie, Boyd, and Fullarton falling into an ambush became the prisoners of Robert of Ogle,[3] a well known and gallant Northumbrian, probably at the time stationed not far from Hexham in Tynedale. (*Rotuli Scotiæ* i., 389, 649). This group of Ayrshire knights was a profitable capture for Robert of Ogle, who exacted a large ransom for these newly belted tyros of chivalry.

"Tyro":—that is the epithet applied by Bower (*Scotichronicon* ii. 334) and equally involved in Wyntoun's expression about the young knights' winning their "schone," or as we might now phrase it, winning their spurs. By the usage of chivalry, the seven years of infancy were followed by seven years of pagehood; then seven years of service as esquire (La Curne's *Memoires* (1826) i. 27, 51) made the tyro eligible for knighthood, at that time usually conferred on the field. Hugo, therefore, it is clear, must have been over twenty-one years of age in 1342. One of his comrades in misfortune was "Stewart," probably one of the brothers of Robert the Steward. The value of the story of the capture is that it identifies the prisoner of 1342 with Hugo, and proves that he was

(1) *Registrum Passelet.* pp. 27-46. Mr. John Edwards in *Glasgow Archæological Society's Transactions* (1899,) New Series, iii. 320, 320.

(2) *Bain's Cal.* ii. 1099.

(3) Robert of Ogle is mentioned by Barbour in *The Bruce* xix. 359.

then over twenty-one. So our Calendar may begin with a pretty safe inference that he was born about, or perhaps not long before, the year 1320.

II.—A Calendar of the Public Life of Sir Hew of Eglintoun.

1320.—About this time, or perhaps not long before, Hugo de Eglintona is born.

In 1341 David II. returns from France.

1342.—Hugo is knighted and takes part in an expedition of David II. into England, thus described :—

Syne rade he thryis wyth stalwart hand
Owt owre the marchis off Ingland,
And first he rade in his manere
Undyre off Murrave the Erlis banere,
And brynt Penyre, and wyth-all
Than off the Rois be brynt the Hall.
Syne efftyrwart a rade off were
He made with displayid banere,
Qwhare the knychtis that he had made,
Owtwartis to wyn thare schone than rade
Wyth a rycht sturdy company.
Robert off Ogill wes nere thareby
Wyth a gret rowte, and qwhen he sawe
Thai knychtis swa cum in till a schawe,
He wythdrw hym (for wys wes he
And in till weris awyssé)
Wythin myris in till a qwhawe
That wes lyand nere that schawe.
The knychtis that sawe his wythdrawyng
Thai folowyd fast on in a lyng,
And prekyd swa owt off aray,
Qwhill off thare folk in myris lay
That thare levyd noucht fyfty
Togyddyr in all that company.
Than Ogill turnyd and abade,
And thai in hy upon hym rade,
And justyd off were apertly:
Thare wes a bargane off felny.
On bathe the halffis slane war men,
Bot the knychtis the wers had then
For thare folk vencust ware ilkane,
And fyve knychtis in fycht ware tane—

Stwart, Eglyntown, and Cragy,
Boyde and Fowlartown. Thir worthy
Ogill has had till his presowne,
And syne delyveryd thame for rawnsoune.
—*Wyntoun* viii., 5981-6010.

The corresponding passage in Bower (ii. 334) states that David II., with a great army and with banner displayed, entered England, and of his tyros whom he there girt with the sword of knighthood, five of the number, viz., Stewart, Eglinton, Cragy, Boyd, and Fullarton, Sir Robert of Ogil guilefully circumventing took prisoners in a marsh. After they had redeemed themselves by a great sum of gold, he sent them despoiled (*vacuos*) to the king.

If in the first expedition the tyro Hew took part, he would make acquaintance with the Tarn Wadling, which lies on the direct route from Carlisle to Penrith. Tarn Wadling plays a large part in the *Awntyrs of Arthure.*

In 1346, David II. is captured at the battle of Durham or Neville's Cross.

1347.—Sir Hew gets the "relief" of Meldrum granted to him by Robert the Steward.

1348.—June 20.—Sir William More, at Linlithgow, grants to Sir Hew and to "Agnes, my sister, his wife," lands in Cowall, Argyllshire (held *in capite* of the Steward) in security of 200 marks. —*Confirmation charter circa 1373, noted of that date below.*

Sir Hew has thus married the daughter of the Chamberlain of Scotland. Sir Reginald More died in 1341.

—*Exchequer Rolls* i., 543.

1357.—March 15.—Sir Hew, along with the Steward, witnesses charter by David II. at Edinburgh.

—*Book of Carlaverock* ii., 411.

On October 3, a treaty is concluded at Berwick for the release of David II., who had remained prisoner in England ever since 1346.

1358.—May 8.—Robert the Steward, in his court (*curia nostra*) at Crieff, confirms a charter, and Sir Hew is a witness.

—*Registrum de Insula Missarum (Inchaffery)*, p. 55.

May 11.—Safe conduct is granted at Westminster for Sir Hew to pass into and return from England, with six knights.

—*Rotuli Scotiæ* i., 823a.

Sir Hew is probably enough already on his way to London when this special safe conduct is granted, and may have travelled

with the Queen of Scotland and Sir Robert of Erskine, (*Rot. Scot.* i., 822.) A proclamation has been made giving a general permission to attend the Festival of St. George (23rd April), at which there are great tournaments. (*Knyghton:* year 1358.)

Nine days later, John, eldest son of the Steward, has safe conduct also, to visit the shrines of the saints in England.

On June 6, the Steward himself has safe conduct.

On June 24, his son John, a hostage, is released by Edward III.

On July 14, David II. has licence to proceed to England.

—*Rotuli Scotiæ* i., 828.

The Kyng Davy in Yngland raid
As offt tym in oys he had,
And at Lundoun play hym wald he,
For thare was rycht gret specialte
Betwen hym and the Kyng Edward.

—*Wyntoun* viii., 7047.

One is prone to ask the question: Was David II., like some other kings, ever made a Knight of the Garter?

November 12.—Sir Hew witnesses charter of lands in Garioch, Aberdeenshire, to Sir Robert of Erskine by David II. at Scone.

— *Acts Parl. Scot.* i., 524. *Aberdeen and Banff Collections* i., 539.

1358-9.—January 11.—Safe conduct is granted at Westminster for Sir Hew, with Sir Archibald Douglas, to pass into England as far as Canterbury, to return by way of London to Scotland, and to go back again to England—to last till Easter.

—*Rot. Scot.* i., 833a.

1358-9.—February 21.—The signets of David II., Thomas Earl of Mar, Sir Robert of Erskine, and Sir Hew ("of Engelton") are, in the absence of the Great Seal of Scotland, appended to a declaration by David II. that the respite granted to him in paying an instalment of his ransom is not to prejudice the rights of Edward III. under the treaty. This declaration is sealed at the Friars Preachers, London.

—*Bain's Cal.* iv., 27.

The position of Thomas, Earl of Mar, as Chamberlain, and Sir Robert of Erskine and Sir Hew, as the two Justiciars of Scotland, at this period, naturally accounts for their being concerned in this negotiation. Sir Robert of Erskine appears to have in a peculiar degree enjoyed the confidence of David II., although he also was in constant association with Sir Hew, and possibly no less faithful to the interests of the Steward, the heir to the throne.

1359.—Sir Hew gets allowance of 20s. remission of customs duty by David II.

—*Exchequer Rolls* i., 600.

1359-60.—January 10.—The Steward and Sir Hew witness a charter by David II. at Edinburgh. Sir Robert of Erskine and Sir Hew are here designated as Justiciars.

—*Douglas Book* iii., 395.

March 23.—Sir Hew witnesses a charter in favour of Sir Robert of Erskine by David II. at Stirling.

—*Registrum Episcop. Brechinensis* i., 17.

1360.—Sir Hew pays contribution of Cunningham towards the King's ransom.

—*Exchequer Rolls* ii., 47.

1360.—May 17.—On the bank of the water of Forth, near Stirling, in presence of Sir Robert of Erskine and Sir Hew, Justiciars of Scotland *(Justiciariorum Scocie)*, an agreement of reconciliation and assythment is made between John of Drummond on the one part and John and Alexander of Menteith on the other regarding the slaughter of Walter of Menteith and Malcolm and William, his brother, by the said John of Drummond and others. Robert the Steward, as head of both the clans, also concurs and remits all suit for said slaughter.

—*Book of Menteith* ii., 239.

1360 (circa).—Robert the Steward grants to Sir Hew and Dame Egidia, his wife, an annual rent of a stone of wax from Monfodevrry, in Cunningham.

—*Mem. Montgom.* ii., 3. *Eglinton MSS. (Hist. MSS. Com.)*, p. 6.

The Lady Egidia was a half-sister of Robert the Steward, and at the time of her marriage to Sir Hew was the widow of Sir James Lindsay. Sir Hew's second marriage thus connected him still more closely than his first in relationship with Robert the Steward.

The charter has interest as suggesting where Sir Hew's midnight oil came from.

May 25.—A charter is granted at Edinburgh by the Earl of Angus in favour of Sir Hew granting lands in Cowall. The Steward is a witness.

—*Mem. Montgom.* ii., 4. *Eglinton MSS.*, p. 7.

October 20.—Sir Hew witnesses a charter by David II. at Perth in favour of Sir James of Douglas of Dalkeith.

—*Honor of Morton* ii., 56.

1361.—Sir Hew pays contribution of Cunningham.

—*Exch. Rolls* ii., 75.

In this year the Foul Death makes its second visitation to England. Wyntoun calls it "the secund Dede." In 1362 it came to Scotland.

—*Wyntoun* viii., 7135.

1361.—Sir Hew witnesses charter by Robert the Steward to Sir John Stewart of Darnley.

—*The Lennox* ii., 33.

1361-2.—January 10.—Sir Hew witnesses charter of Dreghorn by the Steward to above Sir John Stewart.

—*Original in Register House.*

1361-2.—January 17.—Sir Hew receives from John Moray at Ardrossan a charter of Hormishocis in favour of himself and Dame Egidia.

—*Mem. Montgom.* ii, 5. *Eglinton MSS.*, 7.

1362 (circa).—Sir Hew witnesses charter by Robert the Steward at Methven to Maurice of Drummond.

—*Book of Menteith* ii., 249.

After June, 1362, probably between Michaelmas and Martinmas (*Scalacronica*, 202), Johanna, sister of Edward III. and Queen of David II., dies in England and is buried at London.

1363.—April 26.—Safe conduct is granted at Westminster for Sir Hew to pass to England and Canterbury on pilgrimage to the glorious martyr St. Thomas and to return—lasting till Michaelmas.

—*Rot. Scot.* i., 872.

There is a great tilting in Smithfield, London, during the first five days of May (*Walsingham:* years 1362-3), in connection, no doubt, with St. George's Festival. By the statutes of the Order of the Garter the actual assemblies are often later than St. George's Day.

David II. marries Margaret of Logie in this month of April, 1363. (*Wyntoun* viii., 7173. *Bower* ii., 369, 379.)

The Steward has been entering into mutual bonds with other discontented nobles, but in May, 1363, he makes submission to, and terms of reconciliation with, the King. (*Bower* ii., 369; See also *Scalacron.* 202-3). The cause of the revolt is not clear, though it is suspected it is connected with proposals next to be noted.

David II. and others (not including the Steward) having gone to London, a remarkable meeting is held there between him and Edward III. and their respective councillors on 27th November,

1363. A leading article provisionally agreed upon is that failing heirs male of the body of David II. the King of England shall succeed to the Kingdom of Scotland. (*Acts Parl. Scot.* i., 493.)

1363.—December 5.—Safe conduct is granted to Sir Hew to pass to and from England with six companions for a year.

—*Rot. Scot.* i. 876.

A similar safe conduct is granted at Westminster to Sir Robert of Erskine on 8th December. (*Rot. Scot.* i., 877a.) It appears, however, from Bain's *Cal.* iv., 93, that Sir Robert is already at the court of Edward III. on 6th December, on which date he and others of the Scottish suite, including John of Logie (the Queen's son), receive rich presents from the English King. The inference is that probably both Sir Robert and Sir Hew are in London when these safe conducts are granted, and that Erskine at any rate has attended the important meeting of 27th November.

The presents on 6th December include very valuable cups given to Earl Douglas and Sir Robert of Erskine, and minor gifts to various officers of the Scottish King's household, including two Scottish knights, unnamed. (*Bain* iv., 93.) The suggestion is very strong that Douglas has been, and Erskine is supposed to be, won over to the English interest. (See Lang's *Hist. of Scotland* i., 263.)

It is peculiar and significant that on 1st January, 1363-4, David II., in two charters to Durham and Coldingham, styles Sir Robert of Erskine by the unique appellation *confederato nostro.* (Raine's *North Durham*, app. Nos. 85, 86.)

On 4th March, 1363-4, the proposal of 27th November is submitted to the Scottish Parliament, which refuses to entertain it, and deputes Sir Robert of Erskine and others to go to London and try to make better terms. (*Acts Parl. Scot.* i., 493.)

The Commissioners go to London, and there a revised proposal is adjusted, which they undertake to report to the Parliament of Scotland without committing themselves to it. By this, the succession to the throne of Scotland, failing heirs male of the body of David II., is to fall to a son of the King of England other than the heir apparent, (*Acts Parl. Scot.* i., 495.) This indicates Prince Lionel, son of Edward III.

These negotiations show how strong a pressure on Scotland was being imposed by Edward III., and how greatly constrained the Scottish statesmen were to keep on good terms with him without surrendering the national independence or provoking a fresh outbreak of the war.

Margaret of Logie, although a fascinating if "full-blown" widow, was, as John Riddell with keen relish points out (*Peer-*

age Law, 984), of "ripened matronly attractions," and of experience in "wiles and allurements," but of "mature age." This last fact gives added point to one of the clauses above mentioned, common to both editions of the English proposal.

There had been special celebrations over King Edward's 50th birthday. (*Knyghton:* year 1363.) It was, above all, an age of chivalry.

1363-4.—January 2.—A petition is granted by Pope Urban V. at Avignon, presented for a dispensation to John Waleys and Elizabeth de Eglinton, who have intermarried although related in the third and fourth degrees of kindred, that they may remain in the marriage contracted, declaring their present and future offspring legitimate.

—*Calendar of Papal Registers, Petitions*, i., 476.

This Elizabeth of Eglinton was presumably Sir Hew's daughter and heiress, who was subsequently married to Sir John of Montgomerie, and whose descendants, Lords of Montgomerie, ultimately became Earls of Eglinton. John Waleys, her present husband, is probably the lord of Riccarton, not far from Eglinton. (*Reg. Episc., Glasg.*, 285.)

1364-5.—January 12.—Sir Hew witnesses a charter by Robert the Steward at Perth, the often-debated and highly important charter wherein is recorded in most formal terms the fact that a papal dispensation had been duly obtained for his marriage with Elizabeth More.

—*Registrum Episcop. Glasguensis*, 273.
Anderson's Diplomata, preface, p. 38.

The political circumstances of the time, and especially the English intrigue above noted, give powerful reason why at this juncture the Steward takes steps to put on a documentary footing the proof of the canonical legality of his union with Elizabeth More. It may be noted that Sir Robert of Erskine is not a witness to the deed. Observe the dates of this entry and of that which follows.

1364-5.—January 13.—Sir Hew attends the meeting of Parliament in the House of the Friars Preachers at Perth, which discusses the revised proposal from England and accepts the terms generally, but substitutes for the proposal about the succession of a younger son of the English King an agreement to grant to him Edward Balliol's lands in Galloway along with the Isle of Man, both to be held as fiefs of Scotland. The re-grant of Annandale which has

been asked by the Scots is left to be dealt with at the pleasure of the English King. The Steward also is present and agrees.

—*Acts Parl. Scot.* i., 495-6.

It is to be noted that the Parliament's refusal of Edward's younger son as heir to the Scottish throne in a certain contingency is not explicit. Was there some subterfuge, ultimately rendered nugatory by Prince Lionel's premature death?

1365.—Sir Hew receives payment of terce due to his wife Dame Egidia from Dundee customs.

—*Exch. Rolls* ii., 222.

These Rolls, vol. ii., shew that this payment was continued in 1366 p. 261, 1368 p. 308, 1369 p. 345, 1370 p. 357, 1371 p. 364, 1372 p. 373, 1373 p. 435, 1374 p. 460, and 1375 p. 500.

May 20.—Safe conduct is granted at Westminster for Sir Hew to pass to and from England with twelve knights for a year.

—*Rot. Scot.* i., 893*b*.

David II. has safe conduct at the same time. A new treaty of peace is made in June.

July 24.—Sir Hew, with the Steward and Sir Robert of Erskine, attends Parliament at Perth, when it is resolved that as a condition of peace Scotland will aid England (if the latter is invaded) with 400 men at arms and 600 archers at the cost of England, and if Scotland is invaded, England will aid her for 120 years with 200 men at arms and 300 archers at the cost of Scotland.

—*Acts Parl. Scot.* i., 497.

At this time intrigue is busy to secure the adhesion of Scotsmen to the English interest. Great numbers of safe conducts are granted to Scottish traders, pilgrims, and students. John Barbour, the poet, receives safe conduct to visit St. Denis in France. Edward III. is cultivating Scotsmen by all means in his power

—*Rotuli Scot.* i., 892, 897, etc.

1366.—July 26.—Sir Hew, in Parliament at Scone, witnesses charter by David II. attesting redelivery of lands of Logie in Strathearn by Robert the Steward, Earl of Strathearn, to Sir John of Logie (the Queen's son).

—*Red Book of Grandtully* i., 132.*

July 26.—The Steward, with Sir Hew and others, gives his consent to the grant to Sir John of Logie, of all and whole the King's lands of Annandale.

—*Red Book* i., 133.*

On 6th July, 1366, Sir Robert of Erskine, Justiciar, holds Justice ayre at Melrose and seals the deed with Seal of Justiciary of Lothian—*Si. Officii Justiciarie Laudonie.*

—*Raine's North Durham*, appx. No. 326.

1366 (circa).—Robert the Steward grants to Sir Hew the offices of Bailie of Cunningham and Chamberlain of Irvine.

—*Mem. Montgom.* 6. *Eglinton MSS.*, 10.

On December 13, 1366 David II. gives John of Logie seisin of Annandale.

—*Bain's Cal.* iv., 127-8. *Exch. Rolls* ii., pref. lviii.

1366.—December 14.—Sir Hew witnesses charter by David II. at Edinburgh.

—*Honor of Morton*, 63.

1366-7.—January 15.—Robert the Steward at Erth grants letter declaring that he has given Sir Hew the office of Bailie of the Barony of Cunningham.

—*Mem. Montgom.* ii. 6. *Eglinton MSS.*, 9.

January 15.—Same place, the Steward grants letters declaring that, as he had given Sir Hew the offices of Bailie and Chamberlain of Irvine, he has also granted him one third of the fines.

—*Mem. Montgom.* ii., 6. *Eglinton MSS.*, 10.

1366-7.—[Undated, but probably of or about the same date as last two entries.] The Steward grants a letter declaring that, as he had given to Sir Hew the offices of Bailie of Cunningham and Chamberlain of the Burgh of Irvine, he is to have for his labour one third of the fines.

—*Mem. Montgom.* ii., 7. *Eglinton MSS.*, 10.

1367.—September 1-4.—At Morehouselaw and Roxburgh Sir Hew is engaged in negotiating a Border treaty for keeping the peace on the Marches. David II. is present on 4th September. This document is in French, and styles Sir Hew as "Mons' Hugh de Eglinton."

—*Rot. Scot.* i., 913-4.

September 27.—Sir Hew attends Parliament at Scone along with the Steward and Sir Robert of Erskine, when drastic provisions are made to overhaul the financial position of the country and the Crown.

—*Acts Parl. Scot.* i., 501.

1367 (circa).—Sir Hew witnesses charter by Robert the Steward relative to Sir William More, the Canons of Sempringham, and the Monastery of Paisley.

—*Registrum Passelet*, 31.

David II. and Queen Margaret have safe conduct to Canterbury on 4th January, 1367-8 (*Rot. Scot.* i., 917*a*).

1362-1368.—Sir Hew witnesses charter by Robert the Steward.

—*The Melvilles, Earls of Melville* iii., 13.

1367-8.—January 22.—Safe conduct is granted at Westminster for Sir Hew to pass with twelve knights to and from London as an envoy (*nuncius*) of David II.

—*Rot. Scot.* i., 917*b*.

1368.—May 10.—Along with the Steward, Sir Hew witnesses charter by David II. at Elgin.

—*Reg. Moraviense*, 319.

1368.—June 12-22.—At the Parliament of Scone, the work of which includes business touching the lawless "Out Isles," it is resolved that the Chamberlain of Scotland, with Sir Hew and three other knights, shall be sent by David II. to visit the four royal castles of Lochleven, Edinburgh, Stirling, and Dunbar, and inspect the fortifications, artillery, and victualling.

—*Acts Parl. Scot.* i., 504.

The judicial business of the Parliament shews the Steward appearing before the King to claim, and Archibald of Douglas to defend, "reason and right" (*de jure et racione*), while in another case a decision is "challenged" (*calumpniatus*). The discussions are purely legal, and it can hardly be doubted that the Justiciars sit with the King.

—*Acts Parl. Scot.* i., 504-6.

It is interesting to turn to the *Awntyrs of Arthure*, lines 345, 350, 362, 680.

June 22.—Sir Hew witnesses charter of Carrick by David II. at Scone to John, eldest son of the Steward.

—*Acts Parl. Scot.* i., 531.

1368.—July 4.—Sir Hew witnesses charter in favour of Sir Robert of Erskine of lands in Garioch by David II. at Stirling.

—*Aberdeen and Banff Collections* i,., 540.

July 9.—Sir Hew witnesses charter in favour of John Lyon by David II. at Stirling.

—*Abd. Banff Col.* i., 550.

August 5.—Sir Hew witnesses charter by John, Earl of Carrick, at Dundonald.

—*Original charter in Register House.*

It is, presumably, after this that the Steward and his three sons are imprisoned by David II. at the supposed instigation of Queen Margaret Logie. (*Bower* ii., 379.) They are in custody during part of 1368 and 1369. (*Exch. Rolls.* ii., 309.)

1369.—June 17.—Safe conduct is granted at Westminster for Sir Hew to pass to and return from France and England with twenty knights—to last for three years.

—*Rot. Scot.* i., 932.

About this time David II. raises his action for the divorce of Queen Margaret Logie. This brings about the release of the Steward and his son. (*Bower* ii., 380.) It seems natural to suppose that Sir Hew's journey to the English parts of France—and perhaps further, to Rome or Avignon—had to do with the divorce. A normal route to Rome in the 14th century passed through Lucerne across Mount "Godard" into Lombardy through Como, Milan, Pontremoli, Pietrasanta, Pisa, and Viterbo. (*Adam of Usk* 72-73.) This is the route of King Arthur in the alliterative *Morte Arthure*. A journey from Scotland to Rome would not occupy two months. Adam of Usk went from London to Rome in 41 days.

1369-70.—January 2.—Sir Hew witnesses a charter by John, Earl of Carrick, at Edinburgh.

—*Honor of Morton*, 83.

In Lent, 1369-70, Queen Margaret Logie is divorced. (*Bower* ii., 380.) She appeals to the Pope.

1370.—May 30.—Robert the Steward at Renfrew grants letter authorising Sir Hew and his heirs to re-enter upon the office of Bailie of Cunningham.

—*Mem. Montgom.* ii., 7. *Eglinton MSS.*, 10.

Possibly the disturbance of Sir Hew's possession of office may have been brought about by the temporary imprisonment of the Steward.

1370-1.—February 22.—DAVID II. dies—succeeded by Robert the Steward as ROBERT II.

At this juncture it is of great importance to note the attitudes of public personages, for the succession of the Steward in spite of his birthrights secured and ratified by Parliamentary settlement was not a matter of course.

Quhen the King Davy thus was dede,
His sister-son in to his sted,
Schere Roberte Stewarte was made King,
Specialy throw the grete helpyng
Off gud Scher Roberte of Erskyne,
That Edinburgh, Dumbertane, and Strevelyne
Had in his kepyng than al thre.
Worthy wys and lele was he,
He knew Roberte the Stewartis rycht,
Therefor he helpit him wyth all his mycht

To gare hym have that his suld be.
Than com he wyth a gret menye
Tyl Lynlythgw, quhare than was
The Erl Wylliame off Douglas,
That schupe hym for to mak hym bare,
Bot George the Erle off March there,
And Johne his brother wyth thare men,
Cam agane the Douglas then,
Sa that this Erle off Douglas
Throuch thare strentht astonyit was.

—*Wyntoun* ix., 1-20.

Can it have been that Douglas was not himself a claimant to the throne (as stated by Bower in a confused and erroneous manner) but represented the English interest and the agreement of 1364? Sir Robert of Erskine was perhaps not expected by either Douglas or Edward III. to play the loyal part he did. Prince Lionel's death, a year before King David's, had perhaps closed that chapter of intrigue.

1371.—March 27.—Sir Hew is probably a witness to the important declaration by John, Earl of Carrick, now Steward of Scotland, of his right of succession as heir apparent of Robert II. His seal is not now attached to the deed, but on a tag is written, *Dominus H. de Eglintone.* The declaration is made at Scone after the coronation of Robert II.

—*National MSS., Scot.* ii., No. xliii. A. Hay's *Vindication of Elizabeth More* (reprinted in Tracts illustrative of Antiq. of Scotland, 1836, p. 141).

1371.—March 30.—Sir Hew witnesses an indenture made at Perth between Robert, Earl of Menteith, the King's son, and Isabella, Countess of Fife, who accepts the Earl as her heir, and assigns to him on certain terms the tower and town of Falkland.

—*Book of Menteith* ii., 253.

In 1369 an important constitutional step had been resolved upon when the Parliament at Perth decided to institute a sort of privy council. (*Acts Parl. Scot.* i., 507-8.) Very little is recorded of this body under David II., but a most important minute of 3rd May, 1371, records the proceedings of one meeting of the similar body called into existence on the accession of Robert II. It probably refers to the first meeting of this privy council, Robert II. having only been crowned on 26th March, 1371.

1371.—May 3.—At Edinburgh, the King being then present there, it was ordained in his privy council concerning the estate or

manner of living of the King and Queen (*in suo consilio de statu seu modo vivendi ipsius Regis et etiam Reginae*), and concerning the ordering and government of his houses and the keeping and maintaining of his castles to the effect contained in another register relative to the arrangements and such like matters not permanent. There were present at said council the Bishop of St. Andrews, the Earl of Douglas, Sir John of Carrick, Chancellor, Sir Walter of Biggar, Chamberlain, Sir Robert of Erskine, Sir James of Douglas, Sir Hew of Eglynton, and John Lyon, keeper of the privy seal.

—*Acts Parl. Scot.* i., 547.

1371.—May 4.—Robert II. at Edinburgh grants to Sir Hew the forfeiture of Giffen in Renfrewshire.

—*Mem. Montgom.* ii., 10. *Reg. Mag. Sig.* i., 84 (292); also 122 (14). *Eglinton MSS.*, 7.

1371.—May 5.—Robert II. at Edinburgh grants to Sir Hew a forfeiture of Allertoun in Kilbride, Lanarkshire.

—*Mem. Montgom.* ii., 11. *Reg. Mag. Sig.* i., 84 (290); also 121 (12).

May 6.—Robert II. at Edinburgh grants to Sir Hew a charter of lands resigned to him by Sir Robert of Erskine.

—*Mem. Montgom.* ii., 11.

1371.—June 13.—Robert II. at St Andrews confirms charter by Sir Hew.

—*Mem. Montgom.* ii., 11. *Reg. Mag. Sig.* i., 82 (279); also 97 (6).

June 24.—Sir Hew, styled Lord of Ardrossan, witnesses charter by John, Earl of Carrick, the Steward, at Dundonald.

—*Reg. Glasg.*, 285.

John Waleys, lord of Riccarton (presumably Sir Hew's son-in-law), is a witness also.

December 4.—Sir Hew witnesses charter by Robert II. at Dundonald.

—*Reg. Glasg.*, 289.

1371-2.—March 5.—Sir Hew witnesses charter to John of Foulartoun by Robert II. at Scone.

—Hay's *Vindication*, 109.

1371-2.—March 9.—Sir Hew witnesses charter by Robert II. at Scone confirming bargain (concerning sale of the county or earldom of Wigtown) between the Earl Thomas Fleming and Archibald of Douglas.

This fact is taken from a Douglas charter transumpt dated January, 1449, in my own possession.

1371-2.—March 10.—Robert II. confirms charter by Sir Hew to Alan of Lauder.

—*Earl of Lauderdale's MSS.*, 611.

1372.—April 8.—Sir Hew witnesses charter by Robert II. at Edinburgh to Burgh of Irvine arising out of a litigation between the burgesses of Ayr and Irvine.

—*Reg. Mag. Sig.*, 86 (302); also 88 (306).

1372.—May 8.—Sir Hew witnesses charter by Robert II. at Edinburgh.

—*Reg. Mag. Sig.*, i., 93 (327); also 98 (10).

1372.—June 28.—Robert II. at Perth grants charter to Sir Hew and his wife, "our dearest sister," of lands of Bonnington, etc. in shire of Edinburgh.

—*Mem. Montgom.*, ii., 12. *Reg. Mag. Sig.* i., 91 (321); also 123 (22).

October 7.—Sir Hew witnesses charter of the county or earldom of Wigtown to Sir Archibald of Douglas by Robert II. at Stirling.

—*Douglas Charter transumpt, above mentioned.*

1372.—October 9.—Sir Hew witnesses charter by Robert II. at Methven of earldom of Strathearn to David, the King's second son.

—*Reg. Mag. Sig.*, i., 87 (304).

1372.—Nov. 4.—Sir Hew witnesses charter by Robert II., at Linlithgow to Sir Robert of Erskine.

—*Hamilton MSS.*, p. 14.

1372-3.—February 7.—Sir Hew sits at Perth as one among several auditors *(auditoribus ad hoc specialiter deputatis)* of exchequer accounts. A colleague is Archdeacon John Barber.

—*Exch. Rolls* ii., 385.

1373.—April 3.—Sir Hew witnesses charter of Robert II. at Scone to Sir Robert of Erskine.

—*Acts Parl.* i., 562.

April 4.—Sir Hew attends Parliament at Scone touching the succession to the throne.

—*Acts Parl.* i., 549.

1373.—April 24.—Sir Hew, along with John, Earl of Carrick, the Steward, at Edinburgh, grants charter concerning question between William More (Sir Hugh's brother-in-law by his first marriage) and the Abbey of Paisley.

—*Reg. Passelet*, 43.

1373.—April 24.—Robert II. at Edinburgh grants to Sir Hew all the hostilages in burghs and elsewhere and the lands thereof which belonged to the late Alexander, Earl of Buchan, and fell to the Crown by the forfeiture of the earl's heirs, and which have not been already given away by the King's predecessors.

—*Original deed in Register House.*

August 24.—Sir Hew witnesses charter by Robert II. at Stirling to Sir Robert of Erskine.

—*Reg. Mag. Sig.* i., 109 (4).

October 24.—He witnesses charter by Robert II. at Dunfermline.

—*Chiefs of Colquhoun* ii., 279.

1373.—November 11.—Robert II. at Ayr grants charter to Sir Hew of forfeiture of Michael of the Lardner.

—*Original deed at Register House.* See also *Mem. Montgom.*, ii., 12. *Reg. Mag. Sig.* i., 103 (41).

[Circa 1373].—Robert II. at Ardnele, Ayrshire, confirms charter of 20th June, 1348 in Sir Hew's favour.

—*Original in Register House.*

Ardnele, 17 miles from Dundonald, is close to Portincross, Ayrshire, the supposed point from which Robert II. used to sail to his residence at Rothesay. Bute was a favourite resort (*Exch. Rolls* ii., pref. lxxxiv.), where his predilections for the chase no doubt had ample scope (*Liber Pluscardensis* i., 311), Robert II. kept his yacht (*Exch. Rolls* iii., 667).

1373.—Sir Hew receives payment of £80 from Sheriff of Lanark (*Exch. Rolls* ii., 418); also of £40 (ii. 419); also of £124 17s. (ii., 421).

1373-4.—February 18.—Sir Hew sits as an auditor *(ad hoc)* at Perth. The clerk of audit is John Barber.

—*Exch. Rolls* ii., 428.

1373-4.—February 24.—Sir Hew witnesses charter of confirmation to William Boyd of Kilmarnock by Robert II. at Perth.

—Hay's *Vindication*, 113.

1374.—October 12.—Robert II. at Perth grants charter of Lochlebogside, Renfrewshire, to Sir Hew and "our dearest sister," subject to payment of 10 marks a year for support of a chaplain in Glasgow Cathedral.

—*Mem. Montgom.* ii., 12; *Reg. Mag. Sig.* i., 136 (51); *also* 158 (20), *and Eglinton MSS.*, p. 7.

1374—November 11.—Payment of £33 6s. 8d. is made to Sir Hew to account of 700 marks granted to him by Robert II. for 7 years. (*Exch. Rolls* ii., 463.) Sir Hew also for the year preceding had got paid £39 11s. 8d. (*Exch. Rolls* ii., 464.) In 1375 he receives £66 13s. 4d. further to account, and the entry states that the item is *ex causa decreta per consilium.*

—*Exch. Rolls* ii., 500 (and see writ noted below of 17th March, 1374-5).

1374-5.—January 2.—Sir Hew witnesses charter by Robert II. at Perth.

—*Reg. Mag. Sig.* i., 141 (73).

January 2.—Ditto.

—*Honor of Morton* ii., 111.

January 2.—Ditto.

—*Honor of Morton* ii., 113.

February 4.—Ditto.

—*Reg. Mag. Sig.* i., 109 (65).

February 17.—Sir Hew sits as auditor at Perth.

—*Exch. Rolls* ii., 455.

March 17.—Robert II. at Perth grants precept to the Chamberlain, declaring his royal indebtedness to "his dearest brother," Sir Hew, in 550 marks, in complement of 700 marks formerly due, and intimating that he had given Sir Hew the Crown wards, reliefs, and marriages on the south side of the water of Forth; these isues to be made up if necessary to 100 marks a year until payment of the 550 marks.

—*Mem. Montgom.* ii., 15. *Eglinton MSS.*, p. 8.

1374-5.—March 21.—At Ardrossan Sir Hew and Hugh of Auldiston make an indenture about a wadset over Cambusbaron, Stirlingshire, in Sir Hew's favour, for 80 marks.

—*Mem. Montgom.* ii., 14. *Reg. Mag. Sig.* i., 138 (61).

1375.—March 28.—Robert II. at Dunfermline confirms a wadset by Hugh of Auldiston over Cambusbaron, Stirlingshire, to Sir Hew.

—*Mem. Montgom.* ii., 13. *Eglinton MSS.*, p. 7.

April 10.—Robert II. at Perth confirms the indenture between Hugh of Auldiston and Sir Hew, above mentioned, under date 21st March, 1374-5.

—*Mem. Montgom.* ii., 14.
Reg. Mag. Sig. i., 138 (61); also 159 (29).

1375.—August 26.—Sir Hew witnesses charter by Robert II. at Perth.

—*Reg. Mag. Sig.* i., 141 (74).

1375-6.—Feb.-March.—John Barbour, twice describing the month of May in *The Bruce*, quotes from the descriptions of May in the alliterative *Destruction of Troy*, believed to have been one of Huchown's poems, while in the two corresponding descriptions of May in the Scottish poem, *The Buik of Alexander*, (which it is maintained by me was also written by Barbour), other quotations are given from the same passages of the alliterative *Troy* poem.

—*Destruction of Troy*, 12969-74, 2734-8, 1056-64. *Bruce*, v., 1-13; xvi., 63-71. *Buik of Alexander*, pp. 107, 248. *Neilson's John Barbour, Poet and Translator* (*Kegan, Paul & Co.*, 1900) pp. 10, 11.

1375-76.—March 5.—Sir Hew sits as an auditor at Perth.

—*Exch. Rolls* ii., 469.

March 14.—Again auditor at Perth.

—*Exch. Rolls* ii., 497.

March 17.—Sir Hew witnesses charter by Robert II. at Perth relative to the office of usher of the King's chancery *(capella)*, resigned by John de Capella.

—*Reg. Mag. Sig.* i., 132 (24), with additional information in the *Roxburgh MSS.*, pp. 26-27.

These documents are of historical interest on the matter of official surnames. William, usher of our chancery *(capella)* was by David II. in 1363 confirmed as heir of Alexander de Capella. In 1376 the office had been given up by John de Capella in favour of William de Camera.

1376.—Sir Hew witnesses a charter by Robert, Earl of Fife (son of Robert II.) of date A.D. 1376 (no month given).

—*History of the Carnegies* ii., 491. *Earl of Southesk's MSS.*, 718.

1376.—June 26.—Robert II. at Perth grants annual rents of 5os. from Drumdow, 8s. 4d. from Stair, 33s. 4d. from Carse, and 40s. from Monyhagane—all in Ayrshire (once the property of Robert de Bruys, "our kinsman," and resigned by him) to Sir Hew, with license to mortify said annual rents, and apply and deliver them at mortmain wherever and to whomsoever he sees expedient.

—*Mem. Montgom.* ii., 16. *Reg. Mag. Sig.* i., 133 (29).

This very interesting permission—*licenciam ad mortificandum dictos annuos redditus et ipsos ad mortuam manum ponendum et tradendum*—has its pathetic suggestion that the good Sir Hew is setting his house in order and about to make his final bequests.

1376.—November 30.—Sir Hew witnesses a confirmation charter by Robert II. at Perth.

—*Reg. Mag. Sig.* i. 129 (8).

The regnal year is *quinto* (Robert II. came to the throne 22nd February, 1370-1), but as the deed confirmed and engrossed in the charter is expressly dated at the Feast of St. Andrew the Apostle (30th November, A.D., 1376), the regnal year of the confirmation charter is probably in error for *sexto.*

1376.—By command of the King, Sir Hew is paid £266 13s. 4d. in gold nobles.

—*Exch. Rolls* ii., 520.

1376.—Sir Hew again obtains from Exchequer £66 13s. 4d. in part payment of 200 marks received in Flanders by William of Lauder.

—*Exch. Rolls* ii., 522.

1376-7.—February 3.—Before this date Sir Hew dies (*Exch. Rolls*, ii., 518-522), probably leaving a will providing an endowment for masses for his soul, to be celebrated in the Monastery of Kilwinning.

—*Mem. Montgom.*, as noted below.

On 23rd September, 1545, Hew, first Earl of Eglinton, made his testament, whereby, among other provisions, he appointed his body to be buried in the choir of the Monastery of Kilwinning, and gave the following directions:

Moreover, I ordain him [my Executor] to cause celebrate a perpetual obit in the Monastery of Kilwinning, and to found the same for the weal of my own soul and that of my wife, as was settled by will (*prout conditum est*) for the weal of the souls of the late Hew of Eglintoune and Lord Alexander Montgomery of that ilk.

—*Mem. Montgom.* ii., 132. *Eglinton MSS.*, 26.

Alexander, Lord Montgomery, was lord from 1429 until 1470. The descent of the family was from Sir Hew of Eglintoun, whose daughter and heiress, Elizabeth (presumably after the death of her first husband, John Wallace of Riccarton), married Sir John of Montgomery, in possession from about 1380 till about 1398. Sir John was succeeded by his son, Sir John (1398-1429), and Sir John's son, Alexander, was the first Lord Montgomery 429-1470), succeeded by Alexander, Lord Montgomery (1470-83), and Hew, the first Earl of Eglinton (1483-1545).

—*Mem. Montgom.* i., 20-5.

1377.—In the Monastery of Kilwinning, therefore, most probably, and in the choir of its church, where the masses are said for his soul, Sir Hew of Eglintoun is buried. REQUIESCAT IN PACE.

III.—The Poetical Testimony.

About 1420 it is written, concerning the conquests of King Arthur and the consequent anger of the Roman Emperor:—

Qharefor the state off the empyre
Hely movyt in to gret ire,
The hawtane message till hym send
That wryttyn in The Brute is kend:
And HUCHOWN OFF THE AWLE RYALE
In till hys GEST HYSTORIALLE
Has tretyd this mar cwnnandly,
Than suffycyand to pronowns am I.
As in oure matere we procede
Sum man may fall this buk to rede
Sall call the Autour to rekles
Or argue perchans hys cunnandnes,
Syne Huchowne off the Awle Ryale
In till hys Gest Hystoryalle
Cauld Lucius Hyberius empryoure
Quhen Kyng off Brettane was Arthoure.
Huchowne bath and the autore
Gyltles ar off gret errore
For the autor fyrst to say [1]
The storyis quha that will assay
Off Iber, Frere Martyne, and Vincens
Storyis to cwn dyd diligens
And Orosius all foure
That mony storys had sene oure
Cald noucht this Lucyus Empryoure
Quhen Kyng off Brettane wes Arthoure.
Bot off The Brwte the story sayis
That Lucyus Hiberius in hys dayis
Wes off the hey state Procurature,
Nowthir cald Kyng na Empryowre
Fra blame than is the Autore qwyte
As [he] befor hym fand to wryte
And men off gud dyscretyowne
Suld excuse and love Huchowne,

---

[1] A variant reading here is:—

For the first Autouris to say
Thar storyis quha that will assay
Off Orosius, Martyne and Innocent
Wrait thare storyis diligent
And zit Josaphus all four
That—[etc., as above].

Wyntoun, ed. Laing, vol. iii., appx. p. xxvi.

That cunnand wes in literature.
He made the GRET GEST OFF ARTHURE,
And the AWNTYRE OFF GAWANE,
THE PYSTYLL als OFF SWETE SWSANE.
He wes curyws in hys style
Fayre off facund and subtille
And ay to plesans and delyte
Made in metyre mete his dyte,
Lytill or nowcht nevyrtheles
Waverand fra the suthfastnes.
Had he cald Lucyus Procurature
Quhare that he cald hym Empyrowre
That had mare grevyd the cadens
Than had relevyd the sentens.
Ane empyroure in propyrté
A comawndoure suld callyd be;
Lucyus swylk mycht have bene kend
Be the message that he send.

—*Wyntoun* v., 4289-4340.

About 1508, in the *Lament for the Makaris*, the poet William Dunbar thus bewails the misdeeds of Death:—

He has done petuously devour
The noble Chaucer of Makaris flouir,
The Monk of Bery and Gower all thre,
Timor mortis conturbat me.

THE GUDE SYR HEW OF EGLINTOUNE,
Et eik Heryot et Wyntoun,
He has tane out of this cuntre,
Timor mortis conturbat me.

Geoffrey Chaucer flourished 1340-1400: John Lydgate, the Monk of Bury (St. Edmunds), flourished 1370-1451: John Gower flourished 1325-1408:—these three being, of course, Englishmen. Sir Hew flourished 1320-1377: Heryot is unknown: Wyntoun flourished about 1360-1424:—three Scotsmen.

IV.—THE NAME HUCHOWN.

With this large body of detail before us concerning Sir Hew of Eglintoun, there should be little difficulty in coming to a decision on the validity of the conclusion reached or endorsed well-nigh a century ago by George Chalmers, in 1806, that he was the person indicated by Wyntoun's reference to Huchown, a conclusion followed by many succeeding critics. My distinguished friend, M. Amours (a colleague in this Society who has

rendered service, the stoutest in Scotland, to alliterative study), recognises in Huchown a Scotsman, though not satisfied that he was Sir Hew. The eminent English philologist, Mr. Henry Bradley neither recognises Sir Hew, nor admits the Scottish nationality of Huchown. The first branch of the present enquiry concerns the name Huchown, to which, as applicable to a relative of a king, two objections have been advanced. One is that, as a form of Hugh, there is no evidence of the name having ever been applied to any person of rank. A second is that, in Wyntoun's context, it is not to be read as a christian name at all but as a surname. It is true that instances occur of Huchon in various spellings, as a name borne by servants. (Amours' *Scottish Alliterative Poems*, introd. lxxiv.) But no proof has been adduced that anywhere it connoted any disparagement or impertinent familiarity. And on the contrary, abundant precedent demonstrates its regular and formal use by persons of rank themselves in the vernacular Scottish of the period immediately following Sir Hew's generation, while on the other hand corresponding instances of Hew, as the form in the vernacular at that time, are still to seek. In the fourteenth century vernacular deeds are so few that the best evidence is almost shut out. Barbour in *The Bruce* in one case uses the name Hew. (*Bruce* ii., 237, 409.) In 1391 we find a person styling himself "Howioun off Fodrygame."[1] At the opening of the fifteenth century, however, a number of vernacular cases may be reckoned such as to make untenable the first objection. The Lords of Lovat[2] used the christian name Huchon in 1416, Huchoune in 1429, and Hew in 1471. So from 1451 until 1454 the worthy man Huchon, Hochon, Hochioun, or Huchone Campbell is a scion of the Loudoun family, whose representative early in the following century is Hew Campbell.[3] It is possible to offer a partial explanation. We must begin in Latin, not with Hugo Hugonis, but with Hugutio Hugutionis, on which Huchon depends. An intermediate French

(1) *Duke of Roxburgh's MSS.* (*Hist. MSS. Com.*), 13; also referred to in *Athenæum*, 5th January, 1901.

(2) *Reg. Mag. Sig.*, 1424-1513, vol. ii., 178, 2612. John Anderson's *Family of Frisel or Fraser*, 56-64. Tytler's *History of Scotland*, vol. ii., Notes, letter F. *Acta Auditorum*, 12. See also *Extracta e variis Cronicis*, 250.

(3) *Duke of Hamilton's MSS.* (*Hist. MSS. Com.*), 25-27, 34.

form is Hugucion, found in England in 1355.[1] Huchon we know in literature as an Anglo-Norman name, applied, for example, to St. Hugh of Lincoln.[2] The second husband of the widow of Alexander III. of Scotland was named Huon.[3] In Scotland when Ragman Roll was drawn up, in 1296, the French record contains many persons named Huwe or Hewe,[4] but to the same period belongs the form Huch.[5] Grey, author of the *Scalacronica*, has Hughe.[6] In 1321 a French list of Scottish names contains both Heuwe and Huchoun,[7] the former among the "gentifs," the latter among the "serjaunz." It was natural that the vernacular style should, at any rate for a considerable time, as shewn by the usage of the Fraser and Campbell families, have adopted the homelier type, although Hew gained the day at last.

Doublets of the same Romance name are not uncommon. The duplication often results from the well-known fact that in the vernacular languages of Europe nouns were sometimes formed both from the nominative and from oblique cases of Latin words Thus, in France—to be compared with Guido, producing Gui, Gy, Guion, and Guidon—Hugo with its accusative Hugonem produced Hugues, Hues, Hue, Huon, and Hugon.[8] In the old French

(1) Hugutio is a Continental form of Hugo. The canonist Hugutio was an Italian (Mr. Paget Toynbee in *Athenæum*, 16th February, 1901). A papal legate to Great Britain in 1176 was Cardinal Hugo, Hugutio, or Hugezoun Petrileonis (*Decem Scriptores*, 1107, 1433). In Haddan and Stubbs', *Concilia*, ii., 241, he is named Uguccione—the modern spelling which is found as early as Dante's time (*Inferno*, xxxiii., 89). Huguicionis is the (Latin) surname of a Florentine in 1333. (*Cal. Close Rolls*, 1333-37, p. 124.) In 1355 Lady Clare bequeathed to Clare Hall, Cambridge, "I Hugucion"—a copy of the canonist's treatise (*Royal Wills*, 1780, p. 31). From Hugution-em, through Anglo-French Hugucion and Huchon to the Scottish Huchown, the descent is perfectly natural and philologically regular.

(2) *Hugues de Lincoln*, ed. Michel, Paris, 1834, cited by M. Amours above.

(3) Stevenson's *Hist. Doc. Scot.*, i., 41.

(4) Bain's *Cal.* ii., pp. 198-214.

(5) Bain's *Cal.* ii., p. 216. Note that Huche was a current form of the place-name Hitchin. (*Cal. Patent Rolls*, 1313-17; *Cal. Close Rolls*, 1323-27.)

(6) Scalacronica, 40. Hughe similarly appears in the *French Chronicle of London.* (*Camden Socy.*), 26, 42.

(7) Bain's *Cal.* iii., 724. Forms in 14th-15th cent. France were Hugue (*Jehan le Bel*, 301), Hue (*Chronique de la Pucelle*, (1859), 265).

(8) Bartsch *Chrestomathie* (1875) 219 has Hugues and Hugon.

romance of *Huon of Bordeaux* the nominative is Hues, the accusative Huon. In the *Roman de Rou* Hue or Huge is the nominative, Huun the accusative. Before the close of the thirteenth century Huon became a nominative. We have seen above that Huch and Hughe are both early forms in Scotland; accordingly we have not only Huchon but Hughon.[1] The anology seems perfect.[2] Hugutio—Hugution-em; Hugo—Hugon-em; Hugues—Hugon; Hues, Hue—Huun, Huon; Hughe—Hughon; Huge, Huch—Huchon, Howjoun; Hutche—Hutcheon.

The declension of proper names was sometimes carried over from Latin and French into Scottish verse at the close of the fourteenth century, though no longer observed as a regular law,[3] and forms at first only proper for the oblique cases established themselves as permanent types irrespective of case.

Historical analysis thus dispels all difficulty. The use of Huchown as a dignified vernacular form is illustrated by concrete examples. But one more remains to be given for its value as shewing that well on in the fifteenth century a reminiscence of the French original of the name curiously emerges. A son of Hew, the third Lord Lovat, was "sirnamed from a long

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(1) Hughonfeld is a Scottish place-name in 1359. (*Exch. Rolls* i., 567.)

(2) Even if Huchon is not an accusative but a diminutive formed just as *cruchon* is from *cruche* (Brachet's *Fr. Dict.*) the explanation is equally effective for the existence of duplicate forms. Compare Hubechon. (*Cal. Close Rolls*, 1330-33, p. 421.)

(3) The following instances of declension of personal names will be of service. They are from Barbour's *Troy Fragments* and the *Legends of the Saints* and the *Buik of Alexander*:—

Adastrume, *Troy* ii., 2456.	Stratoclem, *Leg.* xlix. 196.
Agrippyne, *Leg.* i., 312.	Ursum, *Leg.* xxvi., 331.
Desium, *Leg.* xxii., 301.	Emynedoun, *Alex.* 16., (25).
Jhesum, *Leg.* xxiv., 45.	Pyrroun, *Alex.* 105 (3).
Lucam, *Leg.* ii., 228.	Caleoun, *Alex.* 72 (12).
Appolynen, *Leg.* xxvi., 331.	Claroun, *Alex.* 333 (4).
Onesiphorum, *Leg.* xlix., 145.	Betoun, *Alex.* 113 (20).
Theodosiume, *Leg.* xxiii., 423.	Fezony, *Alex.* 158 (22).
Titum, *Leg.* ii., 228.	Ydory, *Alex.* 162 (7).

Many of these were also used as nominatives, e.g., Agrippyne, Appolyne, Emynedoun, Claroun.

The same usage occurs in Huchown's poems, *e.g.*, Archilagon, Neptolon, Patroculun, Polexenun in *Destruction of Troy*, 6449, 10926, 14011, 14013: Kayon in *Morte Arthure*, 2380, etc.

residence in France Hutcheon Franchack," and his posterity were called Slick-Hustein-Frankich.[1] Hew and Huchown are alternating forms of one name. The first half of the fifteenth century saw Huchon in high repute; the second half saw Huchon in rapid decline, and Hew in the ascendant; though for long afterwards the former maintained the unequal struggle for a footing as a distinctly proper name. On the Borders in 1596 we find it as Hutchon, Huchen, Hutcheon, Howchone, Hutchen. One owner of the name signed himself Howchone Grame, and was sometimes known as Hutche[2]—no doubt a familiar contraction. From beginning to end it seems that Huchown is, as a christian name in our island, a distinctively Scottish type, implying neither nickname nor derogation, and constituting an entirely honourable vernacular synonym for the Latin Hugo. Not unknown to English familiar usage,[3] examples of a corresponding *status* to the Scottish in its recognition by official documents have not yet been presented.

V.—THE AWLE RYALE.

The Christian name thus far cleared of all confusion leaves the approaches open to the Awle Ryale—its sense, its geography, and the relation thereto of our claimant Sir Hew. That Awle Ryale, however to be explained, is a vernacular shape of Aula Regis, Regia or Regalis, is common ground with all philologists and historians. Thus it has a pedigree long enough to satisfy the most exacting requirement. In classical Latinity Aula Regia not only meant a palace, but had acquired a secondary sense on the stage[4] as a term of art for a king's abode. How soon it came to be metaphorically a synonym for, and actual forum of, the supreme administrative and legal body in European states we may not stop to trace. In France of the eleventh century the Aula Regis is, as it long remained, the great place of law.[5] In England the

(1) Anderson's *Family of Fraser*, p. 71. Hustein is evidently a form of Uisdean the common name for Hugh in the Highlands (*Athenæum*, 26th Jan., 1901.

(2) *Calendar of Border Papers* ii., Nos. 253, 257, 318, 320, 325, 332, 418, 497. For the signature see No. 320.

(3) Huchon, Hugo, nomen proprium viri.—*Catholicon Anglicum.*

(4) *Vitruvius* v., 7.

(5) Langlois *Textes relatifs a l' Histoire du Parlement (Collection de Textes)*, 5, 43, 225. Compare Thevenin, *Textes Relatifs aux Institutions Privees*, 113.

evolution makes an almost fascinating study. The hall—which appears to be a word of different root from *aula*, and not philologically to be confounded with it—is in England at first, as it was in France, a structure of wood.[1] It acquires not merely in the case of the Royal abode but in baronial and episcopal dwellings a specialized importance as the proper place of law. The analogy from an English residence of the twelfth century to the Aula Regia is particularly striking. "The manor house," says a most learned scholar, "consisted of three parts—the *halla*, the *domus*, the *thalamus*."[2] Hall, house, and chamber:—it is a division with large consequence, for in a few years the Royal palace develops three distinct sets of courtly duties and functionaries—those of the hall, those of the King's house or hospice, and those of the King's chamber. Some of these functionaries acquire jurisdictions far from the palace, and in a broad sense—nay even in the strictest sense—the Aula Regis which began as the King's manor house grows under various names into His Majesty's Government and administers the entire realm. It was to furnish a singularly potent metaphor to constitutional lawyers both in England and this country, who were to dilate upon it considered as a technical term, perhaps rather beyond the actual warrant for their propositions in direct text. But it assuredly had a large and concrete enough place in the law of tenures,[3] while, considered as the seat of the supreme tribunal, Bracton's allusion to the King's court as tantamount to the King's hall[4] (*sicut aulam regiam*) might well excuse the amplification, by Blackstone and the host that followed him, of the original statement. Beyond doubt the King's hall was the centre of all administrative courtly and legal authority, where the great officers of state had each his judicial, practical, financial, or ceremonial function to execute. The *Fleta*, an English law book dating from the opening of the fourteenth century, has a good deal to say[5] of the pleas of the Aula Regia, and labours to define the limits of the rights and tasks of the many offices great and small. Two offices of outstanding magnitude there are, which in Normandy, England, and Scotland alike have, in varying manners and degrees, position in

(1) See *Halla* and *Hallus* in Ducange.
(2) Archdeacon Hale in *Domesday of St. Paul's* (1858) xv., 129.
(3) *Testa de Nevil*, 114, 173, etc.
(4) *Bracton*, 105*b*.
(5) *Fleta*, 66 et seq.

the Aula Regia. These are the offices of Senescallus, or High Steward and Great Justiciar. In England the former of these somehow lost rank. In Scotland—which was not so instinctively addicted to law as England was—the Justiciar suffers by comparison at first with the Constable, then with the Steward, who, historically,[1] appears to be particularly connected with the ceremonial side of the King's hall as well as with the palace domestic management, and legal administration. But that both retained distinctively their association with the Hall Royal is indisputable. The Hall was the chief messuage—a fact which gave it the special legal position it held under feudalism. In the Hall the King took seisin of his realm by his coronation; in the Hall the coronation challenge was (in and after the fourteenth century) made by the champion of England; in the Hall in fact and by metaphor sat the King and his Justiciars. So of an early English bishop we read that in his hall he sat as tribunal, and that scrupulously there it was that all legal formalities were carried through.[2] Though traceable in Scotland only with far inferior detail the same state of matters existed there both in Church and State.[3]

A circumstance, which if not directly important is at least of curious interest, is that by old Scots law the "hyrdman," or man of the court circle, had under the assise of David I. a specially recognised judicial position.[4] Derived from the Anglo-Saxon *hired* or court, the word and its significant association with the hall are both brought before us in the Huchown poem of *Gawane and the Green Knight*, where[5] the green knight astounds "alle the heredmen in halle."

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(1) As to this and the *Aula Regis* generally see John Millar's *English Government*, Blackstone's *Commentaries* Gilbert Stuart's *History of Scotland*, second edition 1784 appx., pp. 33, 41, 42, 82, 106. *Fleta*, 66-79. *Le Très Ancien Coutumier de Normandie*, ed. Tardif. 1881., introd. lxx-lxxxi., Ducange *Glossarium* voce Senescallus. Hay's *Vindication of Elizabeth More*, pp. 117-121. Wyntoun calls Joseph the "Stewarde" of Egypt (Wyntoun, ii., 352).

(2) *Roll of Richard de Swinfeld, Bishop of Hereford* (Camden Soc.), abstract lxxiv.-v.

(3) See case of use of the Hall of Trinity friars in 1294: *Acts Parl. Scot.* i., 438.

(4) *Acts Parl. Scot.* i., 317, 359.

(5) Line 302.

In feudal tenures again and again the Mote emerges as the chief messuage[1] and place of law; sometimes, as in the case of Tarbolton, Ayrshire, the hall (*aula*), of which the timbers still remained on the top of the Mote, is itself the chief messuage.[2] What was true of the fief held also of the kingdom. The King's hall in Scotland is at once actual structure—to begin with, of wood—and judicial centre and royal court. The building of a new Hall for Alexander III. is recorded[3] in 1264. The charges[4] for a "dorsar" in the King's Hall (*Aula Regis*) in 1329 show that Robert the Bruce's hall of state (like King Arthur's in Huchown's romance, *The Awntyrs of Arthure*[5]) was provided with "dossours" or wall tapestries "full bright." Repairs of the Hall (*aula domini regis*) are paid for[6] in 1331; lawn for it (*aula regia*) is supplied in the same year[7]; and in 1376 an account was audited by Sir Hew of Eglintoun for the woodwork of the roof[8] of the King's *Aula de Edynburgh*. Meanwhile, too, in the scanty records of the judicial and administrative system we are able to glean the fact that in Scotland as in England there was one set of officials for the King's Hall, and another for the King's hospice or house, while the *camera regis* likewise had its place.[9] The "Kingis Haw" was also the subject of provisions by usage and statute; so much so, that even when King James IV. was under canvas there was a special tent designated the "Kingis Hall."[10] As the supreme judicial forum of the King himself sitting in person, our inadequacy in records leaves us unable to adduce evidences for its use as numerous as could be desired, yet there are enough. King David II. did so sit,[11] and

(1) The Motes in Norman Scotland (*Scottish Review*, October, 1898).

(2) *Reg. Mag. Sig.*, 1424-1513, No. 3691.

(3) *Exch. Rolls*, i., 18. (4) *Exch. Rolls*, i., 255.

(5) Line 444. (6) *Exch. Rolls*, i., 360.

(7) *Exch. Rolls*, i., 389 (*bis.*) (8) *Exch. Rolls*, ii., 472.

(9) *Exch. Rolls*, i., 156-7, *senescallus domus domini regis;* i., 389-90, payments or supplies to different officers, *pro aula regia* and *pro camera regia* or *regis*. Ordinances for the royal hospice were of old standing in 1292: *Acts Parl. Scot.* i., 114.

(10) Acts Parl. Scot. i., 710 deals separately with the *aula*, *domus*, and *camera regis*. Lord High Treasurer's Accounts, i., 174, 182, 185, 293, 346. The explanation of the special tent probably is the provision of a special table reserved for a privileged few. Compare in England *Liber Quotidianus Garderobae*, 92, 200, 201.

(11) Acts Parl. Scot. i., 507.

the *Aula Domini nostri Regis* is expressly vouched for[1] as a place of session of the supreme tribunal. That his two justiciars were frequently with him as assessors for his guidance on points of law is an inference hardly capable of doubt. It is natural to give a foremost place to the element of law. The phrase *Awle Ryale* stands so far without a complete parallel, and the nearest approach to one is gained through a legal medium. In old law French, as employed in English plea rolls and year books, Kelham's *Dictionary* has the entry "*Aule*, a hall." Alliterative poems, which are full to the brim of French influence, have such eminently French combinations as "roy reall" and "mounte ryalle," "dese riall" and "sete riall." These quite correspond to the "Siege roial" at Scone named[2] in 1363, styled in Latin[3] in 1292 and 1371 "*Sedes regia.*" To "Awle ryale" the passage is not far, especially when we remember that Wyntoun, the sole employer of the phrase, was himself[4] steeped in the tradition of juridical phrase. Yet after all the legal was only one side of a term so compound; and whilst the ultimate critic will find in every one of the Huchown poems the trace of the lawyer; he will find yet more vivid that of the courtier, and in several he will detect a peculiarly apt recognition of those legal proprieties, courtly regulations, and administrative details which go to make up the Awle Ryale. Nor is the Hall itself forgotten even in its legal connection. In the poem of *Gawane*, it is in King Arthur's Hall at Camelot that the Green Knight demands to "speke raysoun"[5] and delivers his fantastic challenge. In *Morte Arthure*, it is in his hall (in halle) at Carlisle that with notarial signs the Roman senator, with attendant train of knights, as ambassador of the Emperor Lucius Iberius, summons the great romance King of Britain the Broad to appear at Rome on Lammas Day, at prime, "before the King selvyn," to answer why he occupies these lands without the due homage and fealty and tribute recorded in the rolls and register of Rome—a demand laden with allusiveness to

(1) Acts Parl. Scot. i., 508.

(2) Acts Parl. Scot. i., 113, 493. (3) Ibid., i., 545.

(4) See prologue of Wyntoun's ninth book. He has notarial phrases *passim.*

(5) A translated phrase of law; compare *le roy dysoit soun drott. Scalacronica*, 175.

the *Registrum Brevium*.[1] In that hall, too, it is that King Arthur in his council, after seven days, answers the senator by a message to the Emperor, that by Lammas he will be across the channel with his Round Table as an invader, and that soon he will overrun Lorraine and Lombardy and Tuscany, advancing to the siege of Rome—a message which ends by his in turn certifying his summons and appointing for the terrified embassy an exit from England within seven days, assigning them a port to sail from, the length of their days' journeys, their route, and their behaviour on the way, in terms which can only have come from *Bracton* or from *Fleta*, as they are an ingenious adaptation, in studied insult to the majesty of Rome, of the rules for the expatriation of fugitive criminals who have escaped the clutch of secular justice by resort to sanctuary.[2] Finally, the King assures the senator that the safe conduct from Carlisle to the coast which he has granted under his seal will keep them secure as they journey by Watling Street to Sandwich—a road by which Sir Hew of Eglintoun himself had travelled many a time under the sealed safe conduct of Edward III. In the *Awntyrs of Arthure* also the note of law, however poetically disguised, is readily discernible. Again, "Kyng Arthure's Haulle" is the forum of romance litigation wherein Sir Galerun, a disinherited lord of Galloway, appears demanding "reason and right" in a "challenge" as heir, which Sir Gawain "defends," and which is remitted to the judgment of battle fought in the lists before the King, seated on a "scaffold," and ending in the "concord" not unusual in the chivalric duel,[3] to which it was appropriate. In pleas of land, however, concord was not competent,[4] and the poet is careful in this poem to make the King wait till Sir Galerun is vanquished and has surrendered before rising up to make the peace, accompanying this act with a gift of lands to Sir Gawain,

(1) In the *Brut* of Geoffrey and his translators this demand is not cast into the shape of a summons. *Morte Arthure* follows, of course with the largest poetical license, the main lines of a writ of *Quo Warranto*, and complies with the requisites of a summons in naming a certain time and place: the reference to the rolls and register is a sort of allegation of seisin. "To answer why," see *ad respondendum quo warranto* in *Bracton's Note Book*, plea No. 268, in which curiously provision is made for a summons for the defendant's presence on Lammas morrow—*in crastino S. Petri ad Vincula coram Domino Rege*.

(2) *Morte Arthure* lines, 445, 464. *Bracton*, 135*b*-136. *Fleta*, 45-46. See also the *Furnivall Miscellany*, 383. I believe the passage is from *Fleta*.

(3) Compare Neilson *Trial by Combat*, 226, 270. (4) *Ibid.*, 189.

who "releases" his rights to Galloway and "re-infeoffs" the disinherited Galwegian in Cumnock and Carrick and Cunningham and Kyle. The entire detail here is a skilful poetic blend of law and chivalry, displaying a knowledge not only of legal form but of the code of the chivalric duel "The Maner of Batale." Before David II., in 1368, we have already seen that Sir Hew of Eglintoun actually heard a lord of Galloway (Archibald the Grim) argue about right and reason *(de jure et racione)* with the son and brother of the lord of Cumnock and Carrick and Cunningham and Kyle. Sir Hew also was at least once in close fellowship with an important Scottish duel[1] in the same year, 1368.

VI.—HUCHOWN IDENTIFIED WITH SIR HEW.

In the search for the identification of Wyntoun's "Huchown off the Awle Ryale" there are undoubted difficulties—about the poems, about the poet, and even about his nationality—for our English friends, with that practical admiration for everything great which is so distinctively their characteristic, have never been very willing to let us keep Huchown's work, and latterly have even attempted to carry Huchown himself to Oxford and make him a fellow of Oriel. They must regret that Robert of Ogle, in 1342, let his prisoner, Sir Hew of Eglintoun, go! The bare proposal, however rash and ineffective, to deport Huchown now makes it incumbent on us to look narrowly at our vouchers. Wyntoun does not expressly say that Huchown was a Scot, but his manner makes that inference inevitable and necessary, for his words are more than a criticism—there is in them an allusion clearly personal and even affectionate to one whose individuality was known to Wyntoun himself and intelligible to his Scottish audience. Wyntoun, in short, compels us to look for a poet curious of style, eloquent and subtle, "cunnand in literature"—all epithets of marked propriety as applicable to the three works which Wyntoun names as his: the *Morte Arthure*, the *Gawane*, and the *Pistill of Susan*. These too are so named as to imply that the public whom Wyntoun addressed had knowledge of them. Besides, Wyntoun in one line speaks of Huchown's "cadens," and in another of his "metyre"—words which involve

(1) *Rot. Scot.* i., 916, 917.

his use of alliteration,[1] for "cadens" was in the fourteenth century the antithesis of rime. Alliteration is, in fact, the outstanding note of Huchown's work, but that does not help us to answer the question who he was. The single external fact of first-rate moment is Dunbar's linking of three English poets (Chaucer, Lydgate, and Gower), followed by three Scots (Sir Hew of Eglintoun, Heriot, and Wyntoun), thus placing a poet, Sir Hew of Eglintoun, presumably anterior to 1420. We have besides seen that only one Sir Hew of Eglintoun ever existed, so that our Sir Hew, who flourished between 1320 and 1377, whether he was "Huchown" or not, certainly was a poet. This is a mighty factor in the argument.

The objection that a person of Sir Hew's standing could never have been referred to as Huchown, because of the disparagement such a name implied falls completely when it is shown that no shadow of disparagement exists. The vernacular was homelier than the talk of courts. Unfortunately no vernacular writ names the Knight of Eglintoun. Formal deeds all call the King of Scotland David. A will of date 1361, made in French by Humfray de Bohun, contained a humble legacy to his barber Davy;[2] but standard Scottish chronicles call the King of Scotland "Davy," though writing of him[3] with becoming respect and kindliness to boot. "Men of good discretion," said Wyntoun, "should excuse and love Huchown"—gentle words which the haughtiest emperor might not have scorned to think of graven on his tomb.

The other objection is that Huchown was not the poet's Christian name but his surname. Such a surname did exist. One who bore it was the huntsman[4] of Edward II. Probably there were others yet nearer the educated circle of the Edwardian court, but a thousand such would count for nothing in the absence of evidence of poetic reputation. Equally ineffective would be any aspirant basing his claim on a connection with the Oxford name *Aula Regalis*—itself a fictitious etymology, said to have been used to denote Oriel College.[5] A claimant's prolocutor must not only

(1) Horstman's *Rolle of Hampole*, ii., 345. Chaucer's *House of Fame*, 623. In ryme or elles in cadence. Gower's *Confesssio Amantis* (Pauli ii., 82) of rime and of cadence.

(2) Royal Wills, 53.

(3) Barbour's *Bruce*, xiii., 697. Barbour's *Legends of the Saints*, xl., 942. Wyntoun, viii., 3002, 7175, etc.

(4) John Huchyn, *Cal. Close Rolls*, 1327-30, p. 22.

(5) Mr. Henry Bradley in *Athenæum* of 22nd December, 1900, and my reply of 19th January, 1901.

adduce the man but must prove his title to the epithet adhibited by Wyntoun, and, above all, establish his devotion to verse. Oriel so far has discovered no prospect of ever satisfying any one of these three preliminary conditions, and the royal court of Edward III. has not even pretended an interest in Huchown's laurels.

Sir Hew, on the other hand, meets every call: his name suits his reputation suits; his life suits. A few lines only need be spent in demonstrating how his biography is summed up and rounded off, as it were, by the epithet "of the Awle Ryale." His youth has its puzzle, but three facts of his career are significant. His life from the first moment of his being heard of in the records, associates him with David II., with Robert the Steward, and with the family of Sir Reginald More. When David II. for safety was taken to France in 1334 Sir Reginald the Chamberlain went too, and was long with the boy monarch in the exiled court at Chateau Gaillard. The young Hew of Eglintoun may easily have been for a time in the service of David II. and his Queen, the sister of Edward III. An English education is in every way possible. Many Scots were long in England as hostages and prisoners. The literary dialect of the court circle of Scotland between 1330 and 1340 no man can determine. One-half of the south of Scotland during most of the reign of Edward III. was actually at the English faith, and alliterative critics may notice that the lordship of Annandale, which almost touched the Steward's province of Carrick, was held by "The hende Erl of Hereford Humfray de Boun," who patronised the translation of *William of Palerne.* They may also notice that the Steward was once on terms of marriage [1] with an English granddaughter of Gilbert of Clare, Earl of Gloucester, a niece of that Lady Clare who re-founded Clare Hall, Cambridge. The national differences of Scotland and England, profound though they were, did not throw an "unplumbed salt estranging sea" between the culture and family policy of the north and of the south. As regards the relationship between the two courts, nothing is more certain than this, that the critics in England have entirely overlooked the mysteries behind the intrigues over the succession to the Scottish throne. They have leaped to the assumption that in any Scottish bard something of rampant patriotism is to be looked for, the

(1) Scalacronica, 175; Bain's Cal. iii., 492.

absence of which is suspicious. Rather should it be remembered how fond David II. was of "play" in London;

> For thare was rycht gret specialte
> Between hym and the King Edward.[1]

He had good reason for his cordiality, and so had all parties in Scotland. The burden of the ransom was sore, and the nationalists, as well as the King's privy circle, display no small solicitude to avoid action such as might precipitate a crisis. That out of this situation there might even have emerged a poem or two in honour direct or indirect of the Round Table of Edward III., produced by a Scottish poet of the court, seems as absolutely in keeping with the historic surroundings of the time as that Scottish nobles should, in 1363, be receiving cups of gold and silver at the English court, or bargaining about the possible succession of Prince Lionel to the Scottish throne. If in romance, in Huchown's *Morte Arthure*, the King of Scotland brings fifty thousand men "within two eldes"[2] to support King Arthur against Rome; in veritable fact Scotland in 1365 obliged herself to support England against invasion with 600 bowmen and 400 horse. We repeat that we do not yet know the full purport of that "rycht gret specialte," and that such a simple possibility as the grant of a Garter to the Scottish King or a Scottish lord, if it emerged from some hidden corner of record, might remove the last shadow of obscurity from a mighty chapter of literary history.

But to return to Sir Hew, who stands in no need of any hypothetical Garter to establish his connection with the Awle Ryale. His position at court was one of modest dignity. He was not exactly a great nobleman, even under Robert II., for his rank as a witness to royal charters places him usually far down the scale of precedence. As one of the two Justiciars, he ranked after the great lords and knights. Under David II. he does not appear to have reached the inmost circle of influence at court with the King, being perhaps not such a favourite as Sir Robert of Erskine, and cer-

(1) Wyntoun, viii., 7050.

(2) That is, within "youth" and "middle elde," or between 16 and 60 (*Bower*, ii., 172.; *Rot. Scot.*, i., 236). Acts Parl. Scot., i., 497. Observe that in Geoffrey, Hoel of Brittany, promising 60,000 men, comes before the King of Scotland, promising 2,000. In *Morte Arthure* (line 288), the Scottish King, promising 50,000, ranks first in the list of vows in answer to the King's appeal, and is followed by Hoel, promising 30,000.

tainly maintaining the closest footing with Robert the Steward —a fact which most likely made a wary bearing necessary throughout the period after David's capture at Durham in 1346. Yet that he was on the best of terms with King David all the facts confirm. Whatever be the explanation of the series of intrigues, it certainly seems probable that David II., the Earl of Douglas, and Edward III. alike regarded Sir Robert of Erskine as a party to the "band" of 1363-4, that Sir Hew gave his aid and counsel to the Steward at that critical juncture, that his influence with Sir Robert was steadily in the Steward's interest, and that the politic but loyal discretion of Sir Hew had its share in preparing that surprise for the Earl of Douglas, which came when, on the death of King David, Sir Robert of Erskine, as castellan of the three great fortresses—Edinburgh, Stirling, and Dumbarton—declared for the Steward and threw over any remnant of the confederacy which David II. had certainly reckoned his, and which the Earl of Douglas also may have relied upon. At once Sir Hew takes a new place more identified than ever with the court. His membership of the Privy Council of Robert II., his constant attendance at court, his holding office as an auditor, the financial indebtedness of the King to him, the charters in his favour, over and above his kinship by marriage to the King, and his old offices as Chamberlain and Bailie of Cunningham and Irvine, and as Justiciar of Scotland, unite to show that he possessed in the fullest measure the royal trust, and exercised functions—legal, financial, and administrative —such as to associate him specially with the court on almost all its many sides. His earliest public appearance connects him with the Chamberlain of Scotland, his career shows him ever an intimate of the Steward. He attained judicial dignity under David II., and was honoured and promoted by Robert II. His public life was begun under court influences, which carried him forward to its close; and unless we mistrust the word of Wyntoun, unless we mistrust Dunbar's epithet of "the good," this official lifetime had in it features to evoke men's affection, while, at the same time, they admired—as well they might—the scholarship, the unique style, the power of "cadence," the appropriate "metre," and the pervading purity and beauty of the poems of "Huchown off the Awle Ryale."

VII.—Huchown as a Poet.

It was a happy circumstance that Wyntoun, in naming three poems by Huchown, chose three which differ greatly in matter, measure, and style. *Morte Arthure* is wholly in cadence—if cadence indeed be simple alliteration without rime. *Gawane*—if it be *Gawane and the Green Knight*—is chiefly in alliteration also, but in its 2,530 lines it has 88 half-lines, four of which rime *abab* at the end of each of the twenty-two stanzas. *The Awntyrs of Arthure* (which some critics take to be the *Awntyrs of Gawane*) is alliterative likewise, but rimed throughout in a complicated and cleverly-handled form of verse, requiring so much art and skill that it is perfectly astounding to hear a first-class English philologist declare that the poem, in its present form, has been re cast from an unrimed original. It has nine full lines and four half-lines, all riming, and all (except an occasional half-line here and there), alliterative. Almost exactly the same verse structure is employed in the *Pistill*, differing only in this, that the ninth line is a "bob" line of only two syllables.

The *Morte Arthure* is of chief importance as the central poem, establishing not only the author's poetic evolution, but also, in view of Wyntoun's unmistakable reference to, and quotation[1] from it, giving a basis of certainty to the processes necessary to determine the other works which came from the same diligent pen. Elsewhere I have worked out the wonderful evolution proving that the well-known alliterative translation of the *Destruction of Troy* (from which John Barbour in 1376, culled some phrases[2] for his *Bruce*), preceded a poem on the *Siege of Jerusalem*, and that the *Morte Arthure* made use of both these poems. All three are in one measure, the alliterative plainsong of a considerable part of Huchown's work. To attempt to analyse these poems now is impossible. It is enough to say that while the *Destruction of Troy* is direct translation on the whole faithful, the *Siege of Jerusalem* introduces a great many elements not in the sources employed, and the best parts of *Morte Arthure* are the poet's own brilliant embellishment of the story of Arthur and Lucius Iberius, contained in the *Brut* of Geoffrey of Monmouth. A subsequent

(1) Wyntoun, v., 4273-290. *Morte Arthure*, 30-47., and compare varients in Wyntoun (ed. Laing), vol. iii., appx. pp. xxvi-vii.

(2) Neilson, *John Barbour, Poet and Translator*, 10, 11.

work of extraordinary interest is the *Parlement of the Thre Ages*, which evinces its authorship by Huchown through the number of lines and epithets, the same as lines and epithets in *Gawane*, in the *Destruction of Troy*, the *Siege of Jerusalem*, and the *Morte Arthure*, besides using the same authorities, and the identical verse structure of the latter four poems. A pictorial and dramatic contrast of the views of life entertained by Youth, Middle Age, and Age, it is modelled upon an episode in the *Destruction of Troy*, and through the machinery of a dream shews a debate between the three, Youth in Green, Middle Age in Grey, Age in Black. And Age preaches a majestic sermon from that mighty text of the middle ages, the text of Death, and proclaims that all is vanity, by what is in substance an analysis of the whole range of late Latin and Old French romance, current in the fourteenth century. In any view it is a very noble proof of romance-study in Britain; as viewed from the stand-point to which my own studies have led a very plain man's thought, it is a crowning monument of the culture of the Stewart court—that Awle Ryale to which posterity thought fit to link an immortal name.

Chaucer was not yet heard; England had listened to some strange voices which spoke in alliteration; only one supreme poem had been written or was being written, that, viz: of William Langland, the great alliterative poet of the south. A first edition of *Piers the Plowman* may have appeared about the time when the *Destruction of Troy* was being written, and the great alliterative poet of the north was working away at translations as diligently as, somewhat later, Barbour and Chaucer and Lydgate were each to do. It was not an age of much inventiveness; there were stock themes, regarded not as national, but as cosmopolitan—Alexander and Hector and Arthur and Charlemagne. Frenchmen, Germans, and Italians sang the praise of Arthur; Englishmen retailed the royal deeds of Charlemagne. The nations of the earth for once agreed on a set of chivalric ideals. To each Huchown gave his contribution, not repelled from King Arthur because Carlisle was in England. A king in Romance-Land held a wide sway not yet circumscribed by the scruples, either of simple fact or reluctant patriotism. If we ask what of actual contribution of his own to the airy structure of romance did Huchown make, the answer must be manifold. When he was, in the strictest manner, following a Latin or French original, are we to forget our debt of gratitude to one, who, in the middle of the fourteenth century,

thus did sound journey-work for literature? Is the *Destruction of Troy* less a great poem because it, on the whole with such fidelity, transforms the story of Guido of Colonna's prose into alliterative verse, with many a noble turn of phrase, with many an ornament? Is the *Siege of Jerusalem* less powerful as a picture of that terrible event, because its beautiful episode of Veronica and the cure of Titus and Vespasian is drawn partly from the *Legenda Aurea*, and partly from an older source, while its ground-work comes, to a great extent, from Hegesippus? The whole is suffused in the poet's own furnace, and a unity rises out of dissonance. And then we come to *Morte Arthure*. Perhaps in spite of its steady adhesion in outline to Geoffrey of Monmouth, perhaps just because it wavered so little from the tradition of "soothfastness" in that amazing source of a thousand romances, *Morte Arthure* is, with its borrowed "avows"—brought from the *Voeux du Paon*—its unborrowed scenes of knightly battle, and its loftily original portraiture of a sea fight, probably the high water-mark of Arthurian romance; which is to say a very great thing, for the Arthurian ocean is wide and deep. Certainly *Morte Arthure* is a sharply defined and powerful wave which towers along the deep, the green billow sparkling with the sunlit colours of historic fancy, and the white crest agleam with the light which seldom was on sea or land. Yet not in his martial mood, it is in his softer, sweeter, half-sad, almost always religious mood that the charm of Huchown chiefly lies, and some day when the *Life and Works of Huchown* are to be found in popular editions on the same shelf with Langland and Chaucer, and Shakspeare and the gentle Walter Scott, we shall wonder that we have been so long in discovering the earliest and not the meanest of their quality.

IX.—*Sewage Disposal and Sewage Purification: a Critical Study of the Various Modes now in Use from the Points of View of Applicability, Economy, and Efficiency.* By JOHN GLAISTER, M.D., F.F.P.S.G., D.P.H.(Camb.), F.R.S.E., F.C.S., etc., Professor of Forensic Medicine and Public Health, Glasgow University.

[Read before the Society, 20th March, 1901.]

THE question of Sewage Disposal and Sewage Purification is one of the burning questions of to-day, as it has been for several years past; not as to the advisability or necessity of Purification, but in respect to the mode in which it most efficiently can be effected. The time has now gone past, for a variety of reasons, when a corporation or local authority may be permitted to charge the contents of a neighbouring stream with foul materials, the excretory products of its constituents, and the waste liquids of the manufacturing processes in operation within its borders.

It will be well, at this stage, to clearly differentiate between what is meant by the terms Sewage Disposal and Sewage Purification. By the former may be understood any method by which the sewage of a community is conveyed away from its vicinity into a convenient water-way, such as a river, canal, or the sea, without any reference whatever to its purification, other than what the processes of nature may effect; by the latter, the removal from the sewage, in a more or less efficient manner, of those impurities which have been contributed to otherwise more or less clean water, and the restoration to a water-way of an effluent which consists, more or less, of clean water.

In the earlier stages of the history of a populous place the former was the prevailing method where a river, canal, or the sea was convenient into which it might be caused to flood, without any reference to its effects, immediate or remote, upon the population which produced it, or upon the riparian populations farther down the banks of the stream, and, also, without any reference to the amenity of the stream itself. When places were situated not to allow of this being done in this way, in not a few instances

was the sewage passed over land, in the form of broad irrigation, whereby some measure of clarification, at least, was effected or realised.

By reason of the prevalence in the main of the former method, wholesale gross pollution of our streams became consequent, to which, objections becoming multiplied from different points of view, the Legislature had to give attention by appointing a Royal Commission in 1868 "to enquire into the best means of preventing the pollution of rivers," from the comprehensive and conclusive reports of which was passed the Rivers Pollution Prevention Act in the year 1876. Having dealt at some length with this aspect of the question in a former paper to this Society, and which is printed *in extenso* in its *Proceedings*, Vol. XXVIII. pp. 50-96, I do not propose now to further allude to that aspect of the subject. While, therefore, a scheme of Sewage Purification necessarily includes the question of Sewage Disposal, the converse is not equally true.

Even at the present day, notwithstanding the foregoing, there are populous centres which confine themselves solely to the problem of sewage disposal, not because they have any desire to neglect the other aspect of the question, but because the method in use, under the specially-favoured circumstances of their situation, is deemed sufficient and satisfactory. I refer here to populous places situated on the sea-board. But this statement is not applicable to all such places so situated. It happens, however, that where a place is so situated that, within a few miles of it is a suitable stretch of coast-line upon which tidal currents produce an outward movement, the sewage may be conveyed thither by a properly-devised scheme of sewers, and, by storage tanks for storing up the sewage during the period of flood tide, the sewage may be sent out to sea by the ebb tide, and that without the remotest appearance of nuisance or harm. This, for example, is the condition of Brighton, which, as every one knows, is one of the most popular of watering-places. Such a scheme as this, however applicable to such favoured places, is hardly practicable in the case of populous centres which are situated within almost land-locked bays, although the necessary out-fall sewers might be carried out, though at considerable cost. One cannot but unconditionally condemn, however, the only too common practice in many sea-board towns of simply conveying the sewage to the foreshores, and emptying it into the sea under low watermark, without

reference to tidal effects, since experience but too clearly shows that putrescent and putrescible material is cast up on the foreshores by flood-tide to cause, in certain cases, a nuisance. The absence of such tidal influences is perceptible to the olfactory organs of the tourist in summer weather in Venice, for example, where the sewage is emptied into the canals, and where the rise and fall of the tide in the lagoons can usually be measured by inches.

It will thus be seen that only in certain isolated circumstances may a mere properly devised scheme of sewage-disposal subserve the effectiveness of sewage purification. The need for purification measures was undoubtedly brought home to the minds of the public by the unsightliness of our water-ways—such as the Thames at London, the Liffey at Dublin, the Clyde in our city—and also by the Act of Parliament before named. It is futile to argue that a polluted river has no prejudicial effect upon health: it is true, perhaps, that the incidence of cause and effect may fail in establishment, but no one will contend that the relative hygienic value of a pure river and of a grossly polluted river is the same. Advancing knowledge of the far-reaching effects of such conditions upon the collective health of a community, has, fortunately, put an end to all this.

When it became evident to the minds of sanitarians first, and to the mind of the public later, that the products of drains connected with houses at the one end, and with the public sewers at the other, were inimical to health, the first step in the process of prevention was the establishment of measures connected with the sanitation of dwellings, which, through gradual evolution, has now attained a high degree of perfection. From the lessons so learned, followed the need of properly constructed sewers, the installation of skilfully devised schemes of sewerage, and, last of all, the need for the purification of streams which had practically been reduced to the condition of sewers. But all this has taken a long time—a time, however, not too long—since it has been all required for the education of the public. It would be an interesting study to follow out this line of evolution; but as I have dealt, to some extent, with the subject in a paper, also read before this Society, with reference to our own city, and which is published in the *Proceedings* of the Society, Vol. XVII. pp. 259-292 under the title of "The Epidemic History of Glasgow, from 1783 to 1883," I must refrain from it now. But upon this gradual evolution in development in sewage-disposal are subtended several important

points which have affected our later-day consideration of the subject, in ways which many little dream of, and which will be referred to at a later stage.

If we take a general survey of purification measures in the earlier stage of their institution, we see that attempts were made originally to return to the soil what had originally come from it, and, even, at a time when sewers were of a primitive form of construction, and sewage became water-borne, the method which naturally suggested itself was the running of the sewage over a tract of land before it eventually found its way to a water-course. Later, however, as places grew out of all manageable proportion for such a method of disposal and purification, which, in warm weather, tended to become a nuisance, other modes of purification had to be invented and tested by experience. But these processes still inclined to linger round the principle of restoration to the soil, and hence there were suggested the forms known as Intermittent Downward, and Intermittent Upward, Filtration, the former of which now only survives, and that, only in a comparatively listless way. But since none of these proposed methods were adaptable, for reasons to be discussed presently, to very large populous centres, the later developed schemes of purification became, entirely and purely, artificial, and might not improperly be denominated as a new trade-process; from which we had the Method of Precipitation by chemical agents. Last of all, the increasing knowledge of Man regarding the primitive forms causative of fermentation brought us back to a blended or mixed process of natural and artificial agencies, in the Bacteriolytic or Bacteriological system, in which are utilised the natural agencies of decomposition coupled with the most ingenious mechanical applications.

Without overloading this part of the subject, the foregoing may be taken as a fairly accurate chronological history of its evolution. The next question which falls in order to be discussed, is, how was the institution of schemes of Purification affected by the evolution of the sewage-system of a populous place?

There can be no doubt whatever that the development of schemes of sewage purification, and their practicability or applicability to any given populous centre, have been enormously handicapped by the manner in which our initial methods of sewage disposal were carried out. Almost in no particular field of sanitary science can the evolutionary steps towards perfection be

better or more copiously illustrated than in this. The result was clearly due more to the accident of circumstances than to set design. The channels which were originally constructed to carry away sewage from the dwellings, were intended also to subserve the purpose of conveying also the rainfall; and, usually, as this plan was begun in a place long before purification methods were dreamt of, so was it continued as the place increased in size. The result of this was that the combination of the purely excretory products with a variable amount of more or less clean water, made a very dilute sewage, subject to graded variations in these respective constituents, the variable factor in which being the rainfall. Indeed, the respective ratios of sewage to rainfall ranged from the normal ratio in long-continued spells of dry weather, through a decreasing gamut of sewage to rainfall, as the weather was showery, continuously wet, or extremely wet, in which latter state the ratio of sewage was very low indeed. When, therefore, the need for schemes for the purification of sewage became clamant, engineers and sanitarians together, divided themselves into two large classes, the dividing line of which was, whether or not, on the installation of such systems, the existing conditions were to remain, or to be changed. These two classes might be separated as follows, viz.:—1. Those who were in favour of sending the rainfall to the river by one set of channels, and the sewage to the place of purification by a second and separate set of channels. 2. Those who were in favour of sending all water—pure or impure—into the sewer, and thence to the place of purification.

The system advocated in the former came to be known as the separate system, the latter as the combined system, or, as it is called on the Continent, the system of "tout a l'égout."

It would be too large a question to discuss now the respective merits and demerits of these systems, since regarding each of which a great deal might be said for and against. At the same time, it is quite likely that if the question had to be decided with respect to the installation of a sewage disposal and purification system, *ab initio*, for a new populous place, in view of the better construction of sewers and modes of purification, opinion would evidence itself more in favour of the separate than the combined system. Without discussing the merits of the systems to any extent, it may be said without fear of contradiction, that where the sewage alone is put into the sewers, the engineering problem and the purification problem alike become enormously simplified.

For the engineer, instead of having to construct out-fall sewers, which must of necessity be of larger size, because of the periodical, but fitful heavy rainfall which these latitudes not infrequently supply, than would be required for what may be termed a normal or dry-weather flow of sewage, and to construct storm-valves and bye-passes which would enable the over-strained sewers to relieve themselves by passing the sewage straight into the rivers without any attempt at purification, could construct channels of such appropriate size and shape as would more readily adapt themselves to circumstances which would practically be constant, and would be more efficiently self-cleansing, and more easily and effectually ventilated. Equally would this operate in respect of the problem of purification. Instead of, as at present, a very variable flow of sewage being sent to the works, at times amounting, indeed, to a veritable flood, to attempt to purify which would be as futile as it would be illusionary, there would be a more or less constant and even flow of sewage to be dealt with, the purification of which would be more complete; and the effects of the process could be more carefully observed and studied, with a view to improvements in the process.

On the other hand, this very factor of inconstant flow, which spells ruin to effective purification, becomes, in the case of the combined system, the most important factor in the cleansing of the sewers, and the best preventive to prejudice to health from the effects which may arise from the sewers.

With reference to this question of storm-water, the English Local Government Board has framed certain rules for the works to be constructed for any system of sewage purification. They demand that provision shall be made as follows:—

I. To treat *fully* as ordinary sewage one volume of mixed sewage and storm water equal to *three* times the daily dry weather flow.

II. To deal with the excess of storm water up to *six* times the dry weather flow, either by passing it through a special and separate storm filter of sufficient extent, or by delivering it on a special area of prepared land, other than that in use for the treatment of the effluent from the ordinary tanks and filters. And if such a storm-filter is provided, it should be of sufficient area to permit a rate of filtration of 500 gallons per square yard in twenty-four hours.

The Board further insists upon *fixed* weirs being constructed,

which will only come into play when the sewage is diluted with five volumes of storm water.

This is a purely engineering question, but none the less does it prove my contention already laid down, that storm water, no matter how pure—because it cannot be contended that all of it is but dilute sewage—when admitted to the sewers, compels larger works to be constructed at enormously enhanced prime cost of installation.

Whatever opinion any individual person may entertain of the foregoing systems, on one point will all be agreed, which is, that the point at which the efficiency of any scheme of purification breaks down, is the fitful flow of an over-abundant, highly-diluted sewage, which, under the combined system, is carried to the works for purification. To my mind, it is this very same factor which has compelled so much argument respecting the merits or demerits of any one particular purification scheme as compared with another, or others.

But, overhanging the whole question from the practical point of view of a municipality, is that of the enormous expense which is involved in any scheme which proposes to instal anew a separate system where a combined system is already in operation. Quite apart from the general discomfort which is invariably associated with the necessary excavation of streets for the purpose of constructing the second set of channels, and the new connections with the new and old, the prime cost of such an undertaking for a place like Glasgow might well give pause to our city fathers, while, at the same time, crowding out of the horizon of consideration the balancing items on the other side of the ledger, viz., the less amount of ground area required for purification, less cost of working and maintenance, and more constant, even, and efficient purification.

Under existing circumstances, with the combined system in operation, the best we can hope for in the way of purification is a considerable reduction in the impurity of the sewage in the time it is being treated in the works, on the average of the year's operations, while there must be periods when no purification can be attempted of the whole in any way whatever, and other periods when it can be but imperfectly carried out, both due to the increase of storm water. But, at the same time, there will be spells when, the flow of sewage approaching dry weather conditions, the resources of the works are capable of effecting a degree of

efficient purification, better than which it would be Utopian to look for.

Therefore we may take it that in the bulk of our populous centres, our measures of purification are at best but measures of compromise, but, at the same time, measures which may, under existing circumstances, be deemed the best. It would be a pity that Man in his schemes of this kind should leave Nature and her operations out of count altogether. And, with these in our calculation, the balance of impurity which reaches our waterways after the operation of a carefully worked purification scheme, may safely be left to Nature and her processes, without risk of harm.

From what has been said, it is demonstrably clear that in the installation of any scheme of purification in any given place, every circumstance must be duly taken into account, be weighed, and be considered with reference to practicability and applicability to that place, and these again in relation to economy and efficiency. After all has been said, the difference in practical efficiency between any of the schemes of purification which have stood the tests of time and experience, is not sufficiently great to warrant, even in the case of a large populous centre, the expenditure of fabulous sums of money in the installation of any one system over another, since in the long run, the whole question of installation of any one system in any given place in which a certain set of circumstances exist, must be made with reference to these factors, practicability and applicability, which may be considered as one, economy and efficiency.

Where, however, a municipality exists, in which no scheme of any kind is already in existence, and which, because of its rapid growth, needs much new sewering, it would become a question worthy the most serious consideration, whether the separate system should not be established in connection with the scheme of purification to be installed, and for the reasons already described.

There is no more important question demanding consideration in the installation of any scheme, than that of practicability or applicability—a question, the want of consideration of which, I am of opinion, has been too largely and too long lost sight of in these later years of discussion, relative to the best and most efficient methods of purification. It is, to my mind, unfortunate, in some measure, that the various methods which have stood the tests of

time and experience, and which have, therefore, survived, should each have received almost exclusive consideration at the hands, and from the pens, of its advocates. The only result of this, which may be deemed satisfactory, is that the special advocacy has contributed to lead the minds of those specially charged with the duty of sewage-purification to grapple with the facts, and notwithstanding the floods of writing which have been poured forth,—calculated not a little, at times, to bewilder and puzzle. But all this time, the question of practicability or applicability with special reference to any given place, seemed to occupy in these argumentative writings, but a subservient place. The question of sewage-purification is not an academic or abstract question, but is pre-eminently a practical one. My contention has always been, therefore, that the efficiency of any scheme for any given place depended primarily upon its practicability or applicability. And in this term practicability or applicability are locked up many important considerations.

The primary object of any scheme for purification is to purify, so that neither prejudice to health, nor loss of amenity of a stream may result. But how this purification is to be attained must surely be subject to many important factors, such as cost of structural installation, cost of working and of maintenance, easy modes of disposal of sludge—where certain processes are in vogue and to be extended, or are to be initiated—facilities for acquiring land, suitable in kind and extent, where filtration is part of the process, and easy disposal of the effluent.

All these and other factors are involved in the term practicability or applicability, and, depending upon their readiness of being satisfied, determine the practicability—always viewed with reference to compatibility with economy and efficiency. While it may be perfectly true that more than one scheme might be applied to any given place, if viewed regardless of expense, those in charge of the disbursements of the public monies, are bound, unquestionably, to consider the question solely from the point of view of the greatest efficiency coupled with the greatest economy, and, not specially, with reference to the intrinsic merits of any one scheme over another.

Moreover, quite apart from the general question and general conditions, the further question of the character of the sewage itself of the place which is to be purified, must be held to be a not unimportant factor in the choice of the mode to be eventually adopted.

Sewage may be considered to be constituted of the products from three distinct sources, viz. :—

(1) Domestic Sewage, which needs no explanation, but which is composed of nitrogenous and carbonaceous matters ;

(2) Manufacturers' Sewage, or Trade Discharges, which comprehends all the waste fluids from divers Trade processes, and which is composed of the most varied chemical compounds ; and

(3) Municipal Sewage, in which may be included the waste-waters and fluids from stables, cow-byres, the cleansing of streets, courtyards, and public conveniences by water.

The amounts of these, respectively, in the sewage of different places must obviously vary, although if we compare the average sewage of one populous place with that of another of nearly equal size, it is remarkable how identical on general lines the sewage works out.

It is especially with respect to smaller populous centres which are identified with certain special industries, and in which, the ratios between domestic sewage and trade effluents are, therefore, abnormal, that this question has especial significance with reference to purification.

This, again, may be illustrated from another point of view in the case of Glasgow. I have never concealed my opinion with reference to the precipitating agents employed at Dalmarnock Works, that the addition or substitution of Iron would be a valuable auxiliary, for reasons which will be discussed later. But knowing, as anyone conversant with the problem in our city knows, that, below the point of discharge of the effluent, there enter into the river discharges from leather works and tanneries, containing much tannin and gallic acid, which, in the event of iron in excess having been used in the works, would unite with the above substances to produce the black tannate and gallate of iron, and thus make the water of the river blacker than before—if that were possible—I have not deemed it expedient to push my views, recognising that it would be imprudent on the part of the authorities to produce such a result, in view of the education of the citizens.

Then, again, with reference to the flow of sewage with respect to a scheme proposed for any given place, arise some important engineering questions. Obviously, the cheapest and easiest me-

thod of promoting the flow of fluids in pipes is the application of the law of gravity.

Most commonly, this is either wholly, or in great measure, possible; but there are places situated upon what for this question must be practically deemed a dead level, in which the principle of gravitation would not be practicable except at enhanced cost of constructing deeply-placed sewers; hence specially-devised mechanical power must be brought into play, either by pumping by steam-power—as must necessarily be the case in the enlarged scheme for this city—or by utilising natural forces, as in the water-ram, or in Schone's ejectors. Besides, in Liernur's system, which is in operation mainly, if not solely, on the continent of Europe, mechanical power is exclusively used in propelling the sewage to the place of treatment.

These, then, without pretending to cover the whole field, are some of the considerations which imperatively demand attention in the installation of schemes of purification.

It may now be said that all modes of Sewage Disposal and Purification of water-borne sewage may be divided into two main classes, viz.:—

I. NATURAL; and
II. ARTIFICIAL.

Under the former may be comprehended Surface or Broad Irrigation, which under special supervised conditions has been termed Sewage Farming; and under the latter, the methods of treatment by

I. Precipitation, or the chemical method;
II. Intermittent Downward Filtration; and
III. Bacteriolysis or the Bacteriological treatment.

It will be obvious that while this classification is a working one, it is not scientifically good, since in none of the Natural methods is there absent some measure of artifice, and in most of the Artificial, are natural processes and agencies brought into play, especially in respect of the two methods last named.

There are two tests by which, to my mind, any given Method of Purification may be tried, viz.:—(1) Its intrinsic worth when in operation under the most favourable circumstances; and (2) Its applicability to any given place.

Let us put the above-named methods, then, to these tests.

I. *Surface Irrigation.* In this plan, the sewage is conveyed to convenient sloping piece of land, upon the surface of which, by

means of channels in which its flow can be diverted where wanted, the sewage is passed. The percolated water which passes through the soil, ultimately finds its way into natural water-ways, just as the rain does. If the soil be sandy or gravelly, percolation takes place rapidly, provided the surface of the soil is not allowed to become choked by too long continuous flow over the same area. The land, so enriched, is used for the abundant growth of certain kinds of crops. This method has been much adopted in many small rural towns.

On its intrinsic merits, the method cannot be said, when viewed all round, to be a successful or an efficient one. It fails in times of severe rain-fall and frost, and the area of irrigation is apt during warm summer weather, to become objectionably odorous. The greatest possible measure of success from it can only, moreover, be obtained by close attention.

From the point of view of applicability, it can but best serve small rural towns. It is entirely impracticable for large populous centres like Glasgow, not only by reason of the huge cost which the needed land would involve, but also because of its objectionable smelly character, and because of trade effluents. The system, although still in use in Edinburgh, has out-grown its suitability, and there are few to-day who would advocate its employment for a populous centre.

With reference to Sewage Farms, it may be said with absolute correctness, that, with everything else equal, they fail without the closest supervision. With that, however, added to the other conditions, such as suitable land, etc., they may be worked up to a high pitch of efficiency. For example, the sewage of Wrexham, with a population of 12,000 persons, is treated in this manner on an acreage of 84, now increased to 150, the land being good. As all the effluent from this farm runs into the river Dee, above the intake of the Chester Water Company, it is absolutely imperative to enable it to be continued, that the effluent should be good, which would appear to be the case.

Closely allied to Irrigation in several respects is the method of *Intermittent Downward Filtration*, the essential factors of which are :—1st, land suitable in kind and in area ; 2nd, preparation of the land into a series of plots after the fashion of large filter-beds ; and 3rd, a convenient water-way into which to run the effluent. The nearest example of this is the works at Kirkintilloch for the treatment of the joint Lenzie and Kirkintilloch sewage. If these

factors are provided, the intrinsic merits of the scheme as one of purification are high. Not only is there the rapid percolation of the water through the soil, and its restoration in a relatively pure condition to the stream, but there is the action of a variety of micro-organisms in the soil upon the more complex albuminous bodies of the sewage, which are thus split up into innocuous chemical substances, valuable as plant food, and so, the land is enriched for the growth of suitable crops. To all intents and purposes these plots practically conform in their action to the aerobic-contact bed of the Bacteriological System. But the prime cost of installation is very considerable. Not only must the outfall sewers be taken to the site chosen, but the site itself must be specially prepared before being put into operation: and this preparation consists in excavating the area to be used to a depth of six feet, laying at the bottom of this, at more or less regular intervals, agricultural drain pipes, on the top of these, small boulders or broken stones, over these again, gravel, and on top of all, the natural sandy soil of the ground, or imported sandy soil. From a tank at the entrance of the works the sewage can during dry weather flow be run by gravitation to the plots in series, or where the levels do not permit of it, and during storm flow, auxiliary pumping from a reserve tank must be employed. The sewage is distributed by channels to a given plot or plots, working in series, and in such rotation that each plot, or set of plots works for *six* and rests for *eighteen* hours, by which means the soil is prevented from becoming clogged, and re-aeration of its pores established. The percolated or filtered fluid, which constitutes the effluent, finds its way by an artificially prepared channel which unites those from the bottom of each bed or plot; and from thence to the water channel. The solids of the sewage are then incorporated into the soil by ordinary agricultural operations, and thus a soil is made, rich for the growth of crops, such as hay, cabbages, turnips, osiers, etc.; indeed, in a comparatively short time a barren, sandy soil becomes converted into an excellent humus.

The applicability of this method is affected by three main factors: 1st, its relatively high prime cost; 2nd, the extent of land needed for the sewage of a large population; and 3rd, the difficulty of procuring suitable land: and this is particularly true in the case of populous centres. If one bears in mind that the filtering area of ground needed under the best conditions is *one*

acre for every 1,000 of population, and under less favourable, one acre for 150 to 200 of population, it would mean for a city like ours an area of land of a size somewhere between 1,000 and 4,000 acres. If, moreover, we contemplate the cost of such land in the neighbourhood of a city like ours, the cost of preparing the land, and the cost of maintenance, it throws the scheme out of court, without ever considering the possible effect which our trade effluents would have on its efficiency. At the same time, the cost of working and maintenance is much less than that of other schemes, and when properly managed the land can be made to yield some return in the crops produced.

Chemical Treatment or Precipitation.

Of the very many substances which have been proposed as chemical precipitants of the organic and inorganic matters in sewage, few have survived the tests of time, cost and efficiency. One may now, indeed, sum up on the fingers of one hand those which have been found practicable and valuable. Here, again, the standards by which their use has been ruled were applicability, economy, efficiency. The substances which have survived those crucial tests are—(*a*) Lime, (*b*) Alumina, (*c*) Magnesia, and (*d*) Iron: used, not singly, but in some form of combination.

Lime is the oldest precipitating agent in point of time of use for the purpose, and at first it was deemed very efficient in its action, until the standard became higher. Unless it were used, however, in sufficient quantity, it failed to precipitate effectually the organic matters, and, when used in such quantities, it produced two objectionable results, viz.: 1st, *an alkaline* effluent, which, because of the alkalinity, became subject to secondary decomposition, and which decomposition was considerable because the effluent was richer in putrescible matter than the sewage was before treatment, hence the stream into which the effluent flowed became actually, in some instances, a definite nuisance; and 2nd, a bulky, decomposable sludge. It was thought next to combine with the above treatment with the lime, and after it had acted, filtration of the effluent, to prevent the escape of the above putrescible matter into the stream; but experience proved the inefficiency even of this to cope with the difficulty, since the soluble putrescible substances passed through the filter and into the river as before, and the finely divided, putrescible, slimy material in suspension rapidly

clogged the filters. Three outstanding objections, therefore, put an end to the use of *caustic lime* by itself, viz.:—

1. Its needed use in comparatively large quantities.
2. The alkaline, and therefore putrescible effluent which it produced; and
3. The bulk and decomposable state of the sludge.

Next came the use of Sulphate of Alumina, in the coarse form, as an adjunct to *lime*. For ages the clarifying property of this substance on liquids containing organic matters in suspension has been known, and its like action upon sewage is well marked. It produced two effects, viz.: a *reduction in the amount of lime needed*, and *a more perfect and more rapid sedimentation of solids*: moreover, the effluent was reduced from the state of alkalinity nearer to that of neutrality, hence the sludge less rapidly decomposed, and further, the quantity of it produced was relatively smaller. The chemical action of this substance upon sewage is to some extent parallel to that of iron, inasmuch as it tends to split up complex and stable albuminous bodies into less stable and complex nitrogenous compounds in a direction towards the formation of ammonia, but it does not possess, like iron, the property of oxidising carbonaceous bodies. When sulphate of alumina and caustic lime are used in combination, interaction takes place, and the sulphuric acid being transferred to the lime leaves the alumina in the form of the Hydrate, Al_2 (O H_6), which being a gelatinous, viscid substance, the more readily carries down mechanically with it particulate matter in suspension in the sewage. The property which alumina has on sewage of fixing nitrogenous matter by entering into some form of loose combination with it, is analogous to its action as a mordant on organic substances in dyeing processes. But relatively to iron, it has less power of fixing phosphoric acid and ammonia, and like lime, it contributes of itself no manurial value to the sludge. The combined use of these precipitants has prevailed for a sufficiently long time as a means of clarifying different kinds of sewage, to prove their efficacy for this purpose up to a certain point. Its use at Coventry, where it was associated with efficient filtration of the effluent, has demonstrated its capability of producing good results just as it has been equally shown, with the like treatment, in the works at Dalmarnock. We must, however, clearly differentiate between the amount of purification produced by the action of the precipitants and the amount due to filtration. The mere effect of the

chemicals, along with a due time-allowance for sedimentation, undoubtedly effects a large measure of purification, but even after they have done their best there is left in suspension a not inconsiderable amount of suspended fine flocculent matter which careful filtration only is capable of removing—and that this is by no means insignificant in amount has been proved by the comparative rapidity with which the upper layers of the sand-filters become choked.

As with lime alone, so with the above combination of lime and alumina, or, indeed, in any scheme of precipitation whatever, there remains behind the sludge, the disposal of which is no unimportant part of the process, and the disposal of which, moreover, has given local authorities more trouble than the clarification of the sewage itself. Nor are the reasons for this far to seek. In the first place, no one who knows the composition of wet sludge, or even of pressed sludge, could claim for it much, if any manurial value, as this is commonly reckoned—at least sufficient in degree to warrant its use on a large scale by agriculturists except for opening up stiff land, since it could not profitably be substituted for other natural or artificial manures. Burghardt, who was referee chemist to the Corporation of Salford in the Sewage Treatment experiments carried on at Weaste in 1890-91, in his paper on "Sewage and its Purification," read before the Incorporated Association of Municipal and County Engineers in 1892, gives an analysis of the fresh sewage sludge from the lime process, as follows :—

Mineral matter	6·22	per cent.
Loss on ignition of dry sludge (organic matter) ...	2·50	,,
Water	91·28	,,
	100·00	

The composition of the above mineral matter in parts per cent. being as follows :—

Silica and insoluble matter	10·418
Ferric oxide and alumina	9·511
Sulphide of iron	0·115
Calcium Carbonate	64·526
,, Sulphate	3·621
Magnesium Carbonate	11·613
	99·804

Analyses of the pressed sludge from Dalmarnock Works, which have been made from time to time by myself, show the following composition of a fairly average sample :—

Composition of pressed sludge in parts per cent. :—

Total solid residue	... = 41·50
Mineral matter	... = 24·38
Organic matter (by ignition)	... = 17·12
	41·50
Water	... = 58·50
	100·00
Total Nitrogen (estimated by Kjeldahl's Method)	... = 0·788
Total Nitrogen in terms of NH_3 ...	... = 0·960

And the following analyses of Dalmarnock compressed and steam-dried sludge cake, ground into powder, called "Globe" manure, by myself and others, show the following composition, viz. :—

	Davidson.	Glaister.
Total solids ...	... = 89·37	= 93·00
Mineral matter	... = 49·70 = 66·5	
Organic ...	... = 39·67 = 26·5	
Water	... = 10·63	= 7·00
	100·00	100·00
Nitrogen	... = 1·73	= 1·9
In terms of Ammonia	... = 2·10	= 2·3

From the foregoing analyses, therefore, the following facts emerge, viz. :—

I. RESPECTING WET SLUDGE :

(1) That it is but a very concentrated sewage ;

(2) That it is difficult of application for any useful purpose ;

(3) That it is of but trifling manurial value ; and from the point of view of practical use, of no manurial value.

II. RESPECTING COMPRESSED SLUDGE :

(1) That it is composed of fully one-half water ;

(2) That it contains less than one per cent of Nitrogen ;

(3) That its manurial value is but slightly improved.

III. Respecting Compressed and Steam-dried Sludge:

(1) That it is a manure of comparatively low value;
(2) That it contains a little more than double the amount of Nitrogen (about 2½ times), which is contained in the compressed cake;
(3) That, by the addition of chemical constituents, it could be made a valuable manure.

But even the Nitrogen which it contains cannot altogether be reckoned as Nitrogen available for plant life, since although it can be reckoned by laboratory processes, it actually exists in the powdered sludge as organised bodies, such as hair, etc., which are not readily, if at all, acted upon by the agencies of Nature. Therefore laboratory figures must not be held to be representative, in this respect, of its realisable manurial value.

Further, the comparatively low figures for Phosphoric Acid indicate, from the known composition of sewage, that the bulk of this valuable manurial element has disappeared from the solids of the sewage, and has probably been swept into the river with the effluent.

Thus the disposal of the sludge becomes a question of larger urgency because of the foregoing facts. In the first place, let us consider what the problem means for this city; on the assumption that, when the enlarged scheme for the city is completed, all the sludge will be press-filtered, and on the basis of the figures of the Dalmarnock Works of the compressed sludge for the year 1897-98, and on the further assumption that the total sewage of the city will be not less than five times the amount already being subjected to treatment at Dalmarnock—all of which are based upon official information and figures—it appears that every year the city will have to deal with between 950,000 and 1,000,000 tons of crude sludge, and to dispose of in one way or another between 90,000 and 100,000 tons of compressed sludge, as the result of operating upon about 20 billion gallons of sewage.

Let us contrast with the above, the estimates of the amount of sludge per annum from the action of various precipitants on average sewage, which were made by Messrs. Newton & Son, on the basis of the Salford experiments in 1890. Their calculations were founded upon the data derived therefrom, and were intended to show the number of tons of sludge, in its crude, compressed, and dry forms respectively, which would result at the end of a

year's working after treatment of a daily flow of 10 million gallons of sewage by various precipitants.

From their figures, I have constructed the following table :—

RESULTS per annum, in tons of wet, pressed, and dried sludge, of treated and non-treated sewage, per 10,000,000 gallons of daily average sewage by various precipitants.

	Tons of Wet Sludge.	Tons of Pressed Sludge.	Tons of Dried Sludge.
Raw sewage (untreated),	58,000	11,680	5,840
Lime only, ...	114,200	22,840	11,420
Ferric chloride only, ...	120,000	24,000	12,000
Iron and alumina, ...	120,000	24,000	12,000
Polarite method, ...	75,000	15,000	7,500
Electrical method, ...	69,000	13,800	6,900

This table, practically, is intended to shew the various sludges and their amounts which would be left, after treatment with the above precipitants, from 3,650,000,000 gallons of sewage. From the figures given from the Dalmarnock Works, we are able to compare the realised results with an estimate. The number of gallons treated at these works during the year 1897-98 was, in round numbers, 3,740,000,000, a figure sufficiently near the former to compare therewith. According to the table, the highest figure for wet sludge from any of the processes is 120,000 tons ; that for Dalmarnock is, roughly, 180,000 tons. For pressed sludge the highest in the table is 12,000, while that for Dalmarnock is, roughly, 17,000 tons. From these figures for Dalmarnock we must either conclude that Glasgow sewage is worse than that of Salford, or that the precipitation is more efficient in the latter works. Without pressing this point, from my personal observations of the working at Dalmarnock, I incline to the latter view.

I do not stop here to discuss the modes of disposal of the sludge which either prevail at present, or are proposed for the future, as time forbids.

As an offshoot of the Lime-alum process, is the A.B.C. process,

which has been in operation for many years in such places as Aylesbury, New Kingston, and several others. The precipitants are alumina, blood, clay, and charcoal, and the mode of treatment is as follows :—As the sewage enters the works it is screened, measured, and mixed with regulated proportions of the three last named chemicals, and then, later, with the sulphate of alumina. Thus mixed, the sewage is sent through four precipitating tanks, in which rapid subsidence of the suspended solids takes place, and out of the fourth flows the effluent, which looks very well, and which is then passed into the river. The precipitated sludge is then pumped to a sludge well, whence it is forced into filter presses. The cake is thereafter dried in a Borwick's drying cylinder, the fumes therefrom being condensed by a scrubber. The product is sold as "native guano." The supporters of this method urge that, in addition to efficient purification of the sewage, which is the prime object, the sludge, treated as described, forms a manure which is innocuous, transportable, inodorous, and distinctly of manurial value. From our experience of the chemical constitution of average sewage, we are bound to say that whatever manurial importance this product possesses must be due to the added ingredients, and not to those native to it.

But while nothing should be said or done to discourage the efforts of municipalities to get rid, with advantage, of such products, it appears to me that hitherto too much has been attempted in this direction. The only reasonable position which a Corporation, embarked upon a scheme of which disposal of sludge is an integral part, ought to take up, is primarily to deem the disposal as a part of the scheme of purification, and therefore inclusive in the expenditure of the process, and that the manufacture ought not to be more than an incident in the process. Whether, however, municipal enterprise will ever go the length of mixing the dried sludge with chemical substances, such as sulphate of ammonia, nitrate of potash, superphosphates, and put it on the market as a product of manurial importance, one cannot predicate, but judging from the views of the sewage engineer at Dalmarnock, this is not as yet anticipated. But without some artificial adjuvants, it seems to me hardly likely that the use of the dried sludge alone will increase in demand.

But there are other precipitating agents than *lime* and *alumina*, which have been found of much value. Iron has been suggested and used for the purpose. I have already referred to its use

experimentally at the Dalmarnock works, and to the favourable opinion there formed of its efficacy, and also I have made mention of the reasons which have postponed its possible extended use. As far back as 1846, and later, in 1858, were patents taken out for the use of iron in the treatment of sewage. The latter, that of Mr. Thomas Spencer, a London analytical chemist, was for "Improvements in the treatment of iron ores and ferruginous sands, and certain applications arising therefrom, No. 1,415."

What are the effects of the use of iron upon the organic matter of sewage? One of the most noteworthy changes which takes place, detectable in the effluent, is the substantial increase in the amount of free ammonia, as compared with the amount in the raw sewage, and the substantial decrease in the albuminoid ammonia. This is due to the splitting up of the albuminoid bodies into their elementary constituents. Now, by what precise action of the iron is this effected? It is, indeed, difficult to answer this question with scientific accuracy, but from our knowledge of the action of ferric chloride on such bodies, it is believed that what happens in sewage is as follows:—The carbon from the carbonaceous bodies, and the nitrogen from the nitrogenous bodies, are set free from their compounds, and the former is oxidised into CO_2, while the nitrogen unites with hydrogen to form NH_3, thus accounting for the increase in free ammonia found in the effluent, and the decrease in the albuminoid ammonia.

Some are of opinion, in which I unite, that the water which is bound up in the hydrated oxide of iron does not exist as true water—which is a very stable compound—but as *Hydroxyl*, which is very unstable, and therefore, that iron salts play a part analogous to the action of permanganate of potash in the laboratory process (Wanklyn), for conversion of albuminoid bodies into ammonia.

If one were to put the foregoing reactions into the language of chemical formulæ, the action of liberating the carbon would be represented as follows:—

$$3\ Fe_2\ (OH)_6 + 3\ C = 6\ Fe\ (OH)_2 + 3\ CO_2 + H_6,$$

in which the hydrated *Ferric* oxide, acting upon the carbon to oxidise it, becomes reduced to the hydrated *Ferrous* oxide, the carbon to be changed into carbon dioxide, and nascent hydrogen to be set free, which, in its turn, unites with the freed nitrogen to form ammonia (NH_3), as will be seen from the next equation.

In the meanwhile, the *ferrous* oxide takes up fresh oxygen from the air to return back to the *ferric state.*

$$6\ Fe\ (OH)_2 + H_6 + N_2 + 3\ H_2\ O + O_3 = 3\ Fe_2\ (OH)_6 + 2\ NH_3$$

In the use of iron as a precipitant, as in the case also of lime and alumina, but for a different reason, filtration of the effluent after the effects of precipitation, is of the greatest importance to permit of re-oxidation of the ferrous oxide.

ITS APPLICATION.

The iron may be added to sewage in a variety of forms, as for example:—

(1) A solution of ferric chloride.
(2) A solution of sulphate of iron, in the International, or "Polarite," or "Ferrozone" process.
(3) A solution of alumino-ferric, or iron alum.
(4) The Barry process.
(5) The electrical process, in which iron is set free by electric action.

The first is used as any other precipitating agent, and needs no further explanation. The second consists in adding to the crude sewage a regulated solution of ferrous sulphate, popularly called "Ferrozone," and in filtering, thereafter, the effluent through filter beds composed of a stratum of magnetic oxide of iron—called "Polarite" by some, and "Magnetite" by others—a ferrosoferric oxide, or magnetic oxide, which is one of the most efficient filtering materials known for ridding waters of organic matters. Indeed, in one instance, these filter beds have been in regular intermittent action for twenty-five years continuously, without impairment of efficiency. The third consists in the solution of iron alum in the crude state being added to the sewage in the usual fashion, as at Southampton, from which there is the precipitant action of the two ingredients.

The use of lime is also quite compatible with iron; not only so, but lime, as used, aids in the more perfect sedimentation of the iron as *ferrous* hydrate, and thus less work is thrown on the filter beds. This combination is used in the *Barry* process, which is the fourth on the above list, the form of iron used being *ferric chloride.* The sewage is first mixed with the iron solution, and, thereafter, with the caustic lime. In this process, adequate filtration is absolutely needful, since the utility of the iron for repeated use is only obtained when the iron is oxidised from the *ferrous*

back to the *ferric* state, and this is easily accomplished by efficient re-aeration of the filter beds during the period of resting.

The last process of which I have taken notice is, although designated the "electrical" process, an iron process in which the iron is shed by the action of electricity into the passing current of sewage, in the manner hereinafter described. In the process, the sewage is made to slowly pass through a chamber which is broken up into part sections by the projections into its interior of iron plates forming flanges. These iron flanges are in the electric circuit, and when the current is in action through the apparatus, one set becomes the negative, and the other the positive poles. From the positive poles *only* hydrated ferrous oxide is produced from the oxygen liberated from the decomposition of the water by the electric current uniting with the iron of the plates. This ferrous oxide is oxidised by the dissolved oxygen of the air in the sewage into *ferric* oxide, acts upon the organic matter by oxidising it, is reduced back to the state of *ferrous* oxide, and so by alternate oxidation and de-oxidation, continues to act so long as there are complex bodies to be split up. Then the sewage mixed with the oxide of iron in suspension passes from the electrolysing chamber into settling tanks, thereafter the effluent is passed through ordinary sand filter beds, which, from experience, remain clear for action for long periods, provided they have alternated times of work and rest.

There is still one more modification of this alum-iron process of which a few words must be said. It is the process carried out for the purification of the Heaton Norris Local Board District Sewage at Heaton Mersey. The points about it of interest are these:—

1. It is a constant flow system. 2. The precipitant in use is alum cake, which is added in the well prior to the sewage passing by gravitation into the precipitation tanks—the alum cake being suspended in the well to be dissolved by the passing sewage. 3. After precipitation, the sewage flows over a sill, forming a cascade about one foot in depth, on its way to the filter beds, thus promoting to some extent the aeration of the oxidisable impurities in the sewage effluent. 4. The filter beds are three in number, and the composition of the filter bed of each is different. No. I. has an area of 60 yards, and the strata of the filter are made up from above downwards, of sand, one inch, coarse and fine gravel, six inches, both of which rest on sanitary tiles, which

are perforated (five openings to one inch). The aeration of the bed is effected by pipes, when the filter is not working. Filter No. I. acts, therefore, only as a mechanical coarse strainer No. II. bed is made up of a layer of Magnetite and sand mixed $2\frac{1}{2}$ inches deep, resting upon gravel. It has an area of 35 yards No. III. bed is made up, from top to bottom, of the following layers—sand, 1 inch, Magnetite, 7 inches, pebbles and tiles as above. It has also an area of 35 yards. The effluent from this process has a bright clear colour, contains no matter in suspension, and possesses no smell. Analyses made of the raw sewage, of the effluent after precipitation, and of the effluent after it has passed No. III. filter, show very considerable purification. Indeed, it is claimed for this system that it combines rapidity of filtration and a decreased filtration area, along with the production of a pure, innocuous effluent, at half the cost of any filtration system now in vogue. And if the filter be made up of the following materials, in order from top to bottom, viz., sand = $2\frac{1}{2}$ to 3 inches; Magnetite, size of peas and beans = one foot; pebbles, small = 6 inches; pebbles, large = 4 inches; coarse gravel = 4 inches, and perforated tiles below all, it is further claimed that it will filter efficiently 2,000 gallons per superficial yard per 24 hours. In the above works, the sewage, which contains *no* trade-effluents, is that of 6,000 persons, and amounts to 240,000 gallons per 24 hours.

The use of iron, moreover, produces more marked fixation of the phosphates in sewage than do either, or both, of lime and alumina. In processes of the latter, the phosphatic fungus undoubtedly developes in the effluent. That has been proved, beyond doubt, both in the laboratory, and in streams, in which latter it forms fine bulky flocculent masses of unsightly-looking fungus.

At this stage it will be necessary to say something regarding the use of iron in the treatment of Glasgow sewage, since I have already referred to it.

In the report of the city analyst of date 24th June, 1892, to the Corporation, the results of tentative experiments with basic ferric chloride are described—the chemical then being called "clarine"—having the following composition:—

	Per cent.
Iron (soluble) as basic perchloride, - -	= 6·02
Iron (soluble) as protochloride, - -	0·19
Iron (insoluble) as peroxide, - - -	2·00
	8·21

The analyst reports as follows:—"The result was very satisfactory as far as the removal of albuminoid ammonia was concerned, as well as the oxidisable organic matter, and although a considerable proportion of the brown colour was removed, the effluent showed a slight but distinct blackish tinge."

Comparative experiments between the above and sulphate of alumina were then made on two different kinds of sewage—one, five and a half times deeper in colour, when filtered, than Loch Katrine water, the other fifty times darker. Mr. Tatlock reported on these as follows:—(which I summarise). For the month of October, the results were identical; for November, decidedly in favour of alumina. But experiments were then made over longer periods, viz.,—for three months, with the result, that for the quarter—April to June inclusive—the results were decidedly in favour of iron; and for the quarter—July to September, inclusive—equal as between the chemicals. One point stands out clear from these experiments, and that is, that when the effluent was of a blackish tint, this was due to deficiency in the amount of lime used, the iron being thus left in solution.

The late Mr. Alsing in his report on the same subject, of date 10th December, 1894, states that "having experimented at Bradford almost eighteen years ago, with perchloride of iron in sewage, I found by observation, at the works here [in Glasgow] that the action of the chemical [that is, iron which had been supplied him from a given firm] showed the same effects—namely, in producing a highly satisfactory flocculation and precipitation, and a clear, inodorous effluent." He goes on to say that the iron in solution is easier of application than the alumina, which, being in blocks, requires to be dissolved; that the difficulties of dealing with the sludge from the iron is not greater than with alumina; but on the other hand, is less difficult; and that the cost, relative to equal efficiency, is in favour of the iron. Mr. Melvin, the engineer at the Dalmarnock works says in his Report, of date 10th December, 1894, "I am still of opinion that a considerable saving would be effected by the adoption of iron as a precipitant, and more so if this chemical was manufactured at the works." At this time, owing to Mr. Tatlock's advice to the Corporation not to use iron because of the discharges from tanneries and dye-works, of sulphide of calcium liquor, and of sulphuretted hydrogen, into the river below the effluent from the Dalmarnock Works, no further steps were taken; and from that point of view, but only

because of the exigencies of the occasion, I concurred in his advice.

This question, however, must be raised afresh, and must be dealt with by the Corporation before the completion of their enlarged undertaking to rid the river of its sewage; and it is in view of that, that the foregoing detailed consideration of the question has been given; for I am decidedly of opinion that iron, when properly used, is a more efficient precipitant than alumina; better for press filtering, and does not affect the value of the sewage, and, moreover, it more thoroughly keeps out of the effluent those phosphates which remain soluble in the presence of the other precipitants, by fixing them in the sludge. This opinion, I may say, is founded upon the results of experiments. In a paper on "Chemistry of Sewage Purification," read before the Society by the late Dr. Wallace, city analyst, and printed in the Proceedings, Vol. XIII. (1) p. 63, dealing with the relative values of precipitants, he said, "The question whether lime or alumina is the more effective agent for the precipitation of sewage has engaged my attention, and the results of my observations appear to indicate that although the alumina produces a somewhat more satisfactory effluent, the advantages obtained by its use are not sufficient to compensate for the greatly increased cost of purification, which may be set down at about four times that of lime. *If, however, a very cheap variety of sulphate of alumina, with some sulphate of iron, can be obtained, or if the liquor obtained by lixiviating calcined alum shale is available; if, in fact, the cost of alumina, or a mixture of alumina and oxide of iron, could be approximated to that of lime, I would have no hesitation in recommending its use in preference to lime.*

This calcined alum shale, which used to be plentiful in the neighbourhood of Glasgow, has roughly the following composition, viz.:—(from Dr. Wallace's paper.)

Soluble Portion.	Per Cent.
Alumina,	3·30
Peroxide of Iron,	9·90
Lime,	·67
Sulphuric Acid,	21·66
Insoluble Portion.	
Alumina,	9·78
Peroxide of Iron,	20·68
Lime,	1·25
Sulphuric Acid,	7·81
Silica,	24·72
	99·77

It is not clear to my mind as yet from want of sufficient experimental proof what exact preparation of iron is best suited for the precipitation of Glasgow Sewage—that must be fully tried—but I have no doubt whatever that some preparation of iron ought to be used, particularly if the powers obtained by the Corporation to transport the sludge to the Firth are to be put in force, since it prevents the rapid secondary decomposition of that material.

The only other precipitant in use which has borne the tests already laid down is that called "chemical salts" the principal compound of which is Magnesium Chloride, and which is used in Hillé's process at Windsor, Tottenham, and other places. It is a modification of the lime process, because lime and a proportion of tar are also added to the sewage; and filtration by irrigation of the effluent is also used.

There is, however, another process, which, ought to receive some consideration, particularly for populations of institutions situated in the country, viz. :—that known as the

METHOD OF THE OXYGEN SEWAGE PURIFICATION COMPANY.

This process may be summed up in a few particulars, as it is an alumina method of precipitation with the additional treatment by an oxidising salt, the Manganate of Soda :—

(1) Suspended matters in the crude sewage are first separated by simple subsidence; (2) Manganate of soda is added, to oxidise the organic matter, that salt giving up oxygen and becoming reduced to the insoluble peroxide of Manganese, which in its subsidence carries down mechanically the particulate sewage. This deposit of peroxide of Manganese is afterwards recovered.

(3) The sewage now so far purified, is next subjected to the action of Sulphate, or Chloride of Alumina, preferably the latter, which causes the floating flocculent matter left from the former part of the process to subside. (4) To the clear resulting effluent from this, are added small quantities of Nitrate of Soda, to aid Nitrification. (5) Thereafter, the sewage is fit to be turned into a river or stream.

In this process, there are, therefore, *three* sediments, viz. :—

(1) The crude solids, deposited by gravity.

(2) The deposit, after use of Manganate of Soda; and

(3) „ „ „ „ a Salt of Alumina.

And the processes involved are three, viz. :—(*a*)mechanical subsidence; (*b*) chemical precipitation; and (*c*) oxidation.

This process is in operation at a large criminal asylum in Ireland, and from chemical analyses of its effluents, and from other reports, seems to do good work.

The Glasgow Enlarged Scheme.

It will be convenient at this stage, now that we have considered the various points with reference to the Treatment by Precipitation, that I should make certain observations upon this enlarged scheme as proposed to be carried out. I base these observations upon the paper of Mr. A. B. M'Donald, the city engineer, which was read before the Institution of Engineers and Shipbuilders of Scotland, and which is printed, with the plans and drawings, and the discussion thereon, in the Transactions of that Body, Vol. XLIII., Part VII. pp. 1-48. With the historical part of the paper, which is most interesting, I do not propose to deal, nor with the engineering side of it, for which I am incompetent, but I propose to notice certain points in connection with it upon which I have already touched in consideration of the general question.

In the first place, with reference to storm-water, Mr. M'Donald frankly acknowledges the difficulty which engineers experience in dealing with this fluctuating item in the total amount of sewage, with respect to size of sewers, and, to the impossibility of treating sewage, in times of continuous and severe rainfall. In his scheme, in these circumstances, the size of the sewers has been constructed to provide for the conduction of the dry weather flow of sewage plus a quarter of an inch of rain in 24 hours, and overflow-bye-passes for the escape of storm water—that is diluted sewage, during times of excessive rainfall. These latter discharge their contents into the Kelvin at the Hayburn sewer in Partick, into the Yoker and Duntocher burns, at the points respectively where these are touched by the outfall sewer. The estimated total amount of sewage from the combined north and south-side schemes is reckoned to be, as dry weather flow, 79 millions of gallons, and as wet weather flow, any figure between that and 163 million gallons, this latter figure representing the total flow the sewers are constructed to carry.

There is one very significant paragraph in the paper to which I desire to attract attention. Mr. M'Donald remarks "In designing the works for the treatment of the sewerage, at Dalmuir, it is intended to depart to some extent from the arrangements carried

out at Dalmarnock by the late Mr. Alsing. These works have been most justly described by all competent authorities in terms of the highest encomium, and they are beyond question creditable in every sense to the reputation and the memory of their lamented designer. The position of the intended works at Dalmuir is, however, different from those at Dalmarnock; *and although there is no physical difficulty in combining at Dalmuir the processes of precipitation and filtration, it does not appear to be either requisite or expedient to do so.* The general arrangements and details of the Dalmuir Works are shown on Plates III., IV. and V." On reference to these plans, especially Plate IV., which shows the tanks, outlet works, and dock at Dalmuir, it will be found that no arrangement has been laid down for any filtration of the precipitated sewage whatever. There is simply a series of six huge tanks, each 750 feet in length, in which sedimentation will take place after addition of the precipitants.

This, it will be noted, is a serious divergence from the installation at Dalmarnock, which was started, ostensibly, at least, as a combined precipitating and filtering process. In view, however, of the comparatively filthy state of the river below the point of effluent from the works, the filtering has but fitfully been employed. That is the reason which has been given publicly from time to time with respect to the disuse of filtering. But it was never anticipated that when the sewage in its entirety was to be kept out of the river that the Corporation would resile from the question of filtration. Two things will inevitably happen if mere precipitation be the whole scheme; the first, that an effluent will be sent into the river which will contain much suspended matter, and, the second, that the effluent will be in a condition in which further putrescence will take place. I am not aware upon whose authority it has been determined to do this, and I should like the Corporation to take its citizens into its confidence on the subject, so that it may publicly be known to whom this is due. It is a pity that the Council do not issue, and have not in the past, issued any reports whatever of the effects of the purification process at Dalmarnock, for then most persons who had not the opportunity to personally watch the process since its inception might have, at least, been able to judge of its efficacy or its results. The public of the city were led to understand that the Corporation were desirous of carrying out the precipitation process at Dalmuir as was in operation at Dalmarnock. When sanitary congress representatives or repre-

sentatives from public bodies visited the works, they were shown the clear effluent from the filters and the heroism of the attendant who quaffed the liquid draught. It is difficult to conceive that it is gravely proposed to omit filtration in the completed scheme, because it cannot be pretended that the effluent after treatment solely by precipitation from the Dalmarnock works, though satisfactory enough in view of the present state of the river, would be a sufficient measure of purification in a purified river. To my mind, filtration is absolutely needful, because the effluent will be battledored and shuttlecocked by the flow and ebb of the tide. Mr. M'Donald expresses the view that "the waters of the purified Clyde will, it is hoped, be not merely free from all organic objection, but as clear and limpid as the sewage effluent which is now exhibited." In that general pious wish I heartily concur, but in view of the proposed omission of filtration—by which, by the way, the "clear and limpid" sewage effluent was obtained, after precipitation—I fear that it would be folly to expect its realisation. I am prepared to take samples from the effluent straight from the ordinary precipitating tanks over the twenty-four hours, and to state that probably outside of six specimens, none will be found without varying amounts of suspended matter.

From what I have ventured to say on this subject, it must not be supposed that I am adverse to the scheme of treatment as proposed by our civic authorities. Having carefully considered the subject from a variety of points of view—and I think I may claim a fair familiarity with the local conditions, and the subject generally —I concur with the authorities in the decision at which they have arrived regarding adherence to the precipitation method of treatment, because of its special applicability to the needs of the city —which I believe is the gauge by which to test it. But I do not agree with the proposal of the city engineer—and I fear he will get few sanitarians acquainted with this subject to think with him —that Glasgow sewage can be safely passed into the river without careful filtration after careful precipitation, for the reasons which I have already given, that the effluent will undergo secondary decomposition and will become odorous, and that in this condition in all weathers it will be moved up and down the river by tidal action, but, in summer weather, will become objectionably odorous. Further, I am distinctly of opinion that as precipitants, further enquiry is necessary on the part of the Corporation respecting the relative values of lime and iron, lime and alumina, and alumina

and iron as conjoined precipitants; and, in view of the excellent results from the use of iron—as magnetite—in filter beds, experimental trials might be made at Dalmarnock. There can be no doubt of the better value of iron, not *seen* so much, probably, in the appearance of the effluent as exhibited by chemical analysis of the effluent. This has been so long the subject of experiment that, I daresay, but for the local conditions of the river it would by this time have been adopted; but now that the whole of the sewage and the trade effluents are to be taken out of the river and treated, there is good reason why it should now be introduced.

It now remains to consider the Bacteriolytic, Biological, or Bacteriological systems of purification.

From time to time during the last half century, since drains for the transportation of night soil came more into general use, when occasion demanded the opening up of a cesspool—which was then the common destination of such drains of isolated houses—into and through which, for many years before, house sewage had passed, observers who expected to find the cesspool full of a mass of highly offensive material, were surprised to find the cesspool comparatively empty, and entirely free from any objectionable offensive odour. Indeed, the only thing to be noticed was a small quantity of black looking mud in the bottom of the receptacle. Unfortunately, interest ceased at the point of noting the foregoing facts, and the reasons therefor were not enquired into. The reason for this is doubtless to be found in the fact that, at that time, the effects of bacteria in the destructive metamorphosis of organic matter were not even dreamt of, much less understood or investigated. Indeed, that only became possible when the natural history of microbes came to be studied, which is a question of the past thirty years or thereby.

It would appear that the first publication which was printed, and which indicated the probable action of micro-organisms as the cause of natural sewage purification, was a pamphlet entitled, "A New, Hermetically Closed, Completely Inodorous, Incessantly Self-Emptying Cesspool, invented by M. Louis Mouras, proprietaire, Vesoul (Haute Sâone)." The pamphlet was written, curiously enough, by a parish priest named Abbé Moigno, and was published in French about the year 1883. The substance of its facts are as follows:—In the year 1881, this M. Mouras asked the Abbé Moigno to publish his observations of a cesspool system, which the former had had in operation for about twenty years

previously. The title of the pamphlet itself informs the reader what the characteristics of the cesspool were. But it is of importance to note, with reference to the purpose we have in view, the special features of the cesspool with reference to air supply. In the first place, it was hermetically closed from the air; in the second, the products of the cesspool, as well as the cesspool itself, were absolutely inodorous; and in the third, the products were found by experience to be valuable as a liquid dressing for cultivated land. According to the writer of the pamphlet, "By a mysterious action which reveals an entirely new principle, the cesspool transforms all that it receives, both solid and liquid evacuations, in a tolerably short time, and without any addition of chemical ingredients, into a homogenous and scarcely turbid liquid, which holds everything in suspension in a state of filaments almost invisible without leaving any deposit against the sides of the soil pipe, or at the bottom of the drain pipe." These were the results found on inspection of the cesspool. It was constantly discharging its surplus contents in the condition above described, which, as has been said, were found well suited for domestic irrigation of a garden or small plot of land.

Not satisfied only with noting the results of the system, the Abbé goes on to discuss the rationale of the causes productive of said results. It is evident, however, from his statement that, as might be expected, he was but groping in the dark. He hints that the result may be due to ammonium sulphide, which, of course, is entirely erroneous. But he adds this significant remark, which, though perhaps, and likely, quite unknown to him, is the true keynote of the process:—

"May it not be discovered that the mysterious agents of this fermentation, cause of the decomposition and liquefaction of the fœces, are the *vibrios*, or rather the anaerobes of M. Pasteur, which the oxygen kills, and which only employ their devouring activity when excluded from the air?"

He thirsted, however, for more information upon the subject, and believing that valuable information could best be obtained by direct observation, he caused a tank to be made with glass sides, so that the whole process of fermentation and metamorphosis might be directly studied under his eye. He then describes the changes which he saw the sewage undergo toward complete disintegration. He thought it possible that gases would be generated by the process of fermentative decomposition, and

to test this he caused a tap to be fixed into the top of the tank, over which he placed a bladder, securely fastened. But he found that practically no distension of the bladder took place, showing that in the absence of air there was no free disengagement of gases, and that they were held in solution in the water, but if air was admitted into the tank, he found that the bladder became quickly filled. He thereupon concluded that, for the more efficient operation of the process, air should be rigidly excluded from the tank. Another point which came under his observation, and which he deemed of importance, was that there should always be present in the tank a certain proportion of water to prevent the sewage becoming saturated with the products of decomposition, as in that event the effects were retarded, if not indeed entirely suspended. Further, the Abbé believed that by the action of the process any disease producing (pathogenic) organisms which might be present would be destroyed, and therefore that the products of the process might be used without the least harmful result, for the irrigation of land. Lastly, it ought to be noted that the process was patented in 1881.

The next account in point of priority comes, strangely enough, from Barcelona. The father of Professor Boyce, Professor of Pathology in University College, Liverpool, received a letter from the British Consul at Barcelona, in 1893, in which the Consul narrated the use of the above system on the property of a merchant in that place in the drainage of his factory and private residence. The Consul states that he had personally inspected the process and its results, the process, at this time, having been in active operation for five years. He examined the tank, and he recorded that the effluent was almost colourless and odourless, and that it could be removed for manurial purposes without the least nuisance. In his letter, in addition, he enclosed a copy of the pamphlet, the contents of which I have just summarised. The above interesting history was recorded by Professor Boyce in *The British Medical Journal*, 1898, Vol. II., p. 273.

In point of time, the next attempt to prove the efficacy of the results of bacterial action on sewage, was that of Cameron in Exeter, in the year 1895-1896, when an experimental installation was laid down to deal with the sewage of a part of a parish in that neighbourhood. The principles which Cameron adopted were practically those which have been described in the pamphlet of the Abbé Moigno, but for the descriptive name of "A New, Hermetically

Closed, Completely Inodorous, Incessantly Self-Emptying Cesspool," Cameron substituted a shorter, viz.—The Septic Tank—in which the action of anaerobic micro-organisms developed, and caused the liquefaction and fermentative decomposition of the solid parts of the sewage. With certain structural differences, the septic tank is but the essential parts of the cesspool of Abbé Moigno. But since the effluent of Cameron's septic tank was not employed in the irrigation of land, but was discharged into a stream, he passed the effluent through beds which, while they exercise filtering action, also develop further microbic action, from which the names "filter beds," "bacteria beds," "contact beds," have been given to them.

One of the most important questions in connection with this system is the area of beds needed, and it is one, moreover, upon which opinion is somewhat divided. For example, Kaye Parry (*Jour. San. Instit.*, Vol. XX. p. 635), says that to obtain a good effluent by filtration of a previously clarified sewage, two acres of artificial filters for every million gallons of sewage treated per day are necessary. This forms a costly item. Baldwin Latham has estimated that the probable cost of artificial filters for Manchester would amount to £300,000, without including cost of purchase of land, working expenses, and renewals.

I am not concerned, at present, with the engineering side of the question, and therefore do not propose to discuss the value and usefulness of the automatic alternating gear invented and patented for the automatic working of the flow of effluent on to these beds (by Cameron), although from the point of view of relative cost of installation, doubtless that would be an important factor.

From a recent examination made of the Septic Tank at Exeter, which has now been in constant operation for more than four years, it was found that the floor only was covered with a "fine deposit, largely mineral," a result which was to be expected, and which is in accordance with the previously recorded observations of the French Abbé.

The Rationale of the System.

The bacterial treatment of sewage has practically resolved itself into the adoption of one of three methods, viz. :—

1. That where the crude sewage is run upon filter, or contact or cultivation beds, composed of coke or other materials, the rate

of flow of the sewage being regulated, and the contact beds themselves subjected to alternate periods of active work and complete rest.

2. That where the crude sewage is first run into a grit chamber, then into a closed dark tank, called the Septic Tank, and thereafter is passed on to the contact beds in a slow but continuous flow, after which the effluent is passed into a neighbouring stream; and

3. That where the crude sewage is passed into an open settling tank, and from thence to the contact beds, and in turn to the stream.

The first may be fitly termed the Aerobic Method, the second, the combined Anaerobic and Aerobic Method, and the third, the same as the second, for although there may be apparent differences in the engineering technique in the third as compared with the second method, essentially the intimate action is identical. These apparent differences may now be described and disposed of. In the settling tank of the *third* method a thick scum gradually forms on its surface, provided that the rate of flow is properly regulated, and this scum, to all practical intents and purposes, plays the part of the roof of the septic tank, inasmuch as it prevents the entrance of light and air to the layers of sewage lying underneath, and so the action of the anaerobic organisms is allowed steadily to proceed. Possibly this effect may, from time to time, be frustrated by the action of violent wind blowing the scum from off some part of the surface of the fluid in the tank, but this only operates for very short periods. We may, therefore, deem in our practical consideration of the question, the second and third methods as being practically identical.

Nothing has been better proved in the whole range of bacteriological work than the power of organisms to split up complex organic bodies into simpler constituents. The compound organic substances found in sewage have as their main constituents, nitrogen, sulphur, carbon, hydrogen, besides other inorganic materials. There are two great groups into which micro-organisms may be divided, viz. :—

1. Those which cannot live in the presence of active oxygen or air, the Anaerobic organisms; and

2. Those which cannot live without the presence of oxygen or air, the Aerobic organisms.

Each group, therefore, is limited as to its growth and activity, and power of work, by the environment.

In the reduction of the complex fluid—sewage—into simpler compounds, each group has a definite part to play. The organic material found in sewage is fitting food for them, and it is because of this the disintegration of organic substances is effected. For example, in the reduction of a compound having the chemical constitution just described, the elements are liberated to form new compounds: thus the liberated sulphur, either forms gases with Hydrogen, or with Nitrogen and Hydrogen combined, or it unites with soluble inorganic elements to form odourless and innocuous salts; the Nitrogen unites with Hydrogen to form Ammonia (NH_3), which, in turn, may unite with other compounds, as Sulphuric Acid, to form the Sulphate of Ammonia.

After the anaerobic organisms have done their share of the work in the dark, airless tank, the sewage is passed over an artificial weir or waterfall, by which it absorbs the gases from the atmosphere, oxygen, nitrogen, and carbonic acid, and thus freshly aerated, it is passed on to the surface of the contact beds. Here two kinds of action take place, viz.:—The mechanical one of filtration, and the biological, in which latter the aerobic microbes take up the work of disorganisation left by the anaerobes, to do fresh work, and mainly of a distinctly different kind. From what has been said of the action of the anaerobes, it will be apparent that their work is mainly *destructive*, in respect that they reduce the higher organic materials into those which are lower and more elementary in chemical composition. The function of the aerobes, on the other hand, since the fluid meanwhile upon which they have to act has received fresh supplies of oxygen from the atmosphere, *construct* out of the more elementary substances already produced, higher chemical substances which are suitable for plant food. And this is how they do it. In the first place, the parts of the contact bed in which they most prevail are the surface and superficial layers of the beds, or when the aeration of the beds is properly attended to, and so long as they remain pervious to the air, through even the whole stratum of the bed. They increase and multiply the more work they have to do, under proper conditions, and the more food provided them in the sewage. Hence it is that the period in the life of a contact bed at which they do their most efficient work is *not* when the filter bed has been newly made, but after it has been in operation for at least a week or ten

days; in short, so soon as the organisms have had time to adequately grow and multiply. Hence the work of the contact bed is not so much that of filtering the effluent, as of further microbic action upon it. As has already been explained, from the closed dark septic tank the products of the putrefactive or fermentative decomposition—nitrogen forming with hydrogen, ammonia, from the nitrogenous substances, and CO_2, and other carbon gases as CH_4 from the non-nitrogenous, pass on to the contact beds. There they are encountered—after the fluid effluent has been oxidised by the absorption of atmospheric gases—by two kinds or classes of bacteria, viz. :—

1. The Nitroso-bacteria; and
2. The Nitro-bacteria.

Each of which exercises a limited but definite action upon the above named products.

The Nitroso-bacteria attack the ammonia and its compounds, and cause the nitrogen to unite with the oxygen, to form *Nitrous* acid, or HNO_2, the lower form of the oxidation of nitrogen, and a comparatively unstable compound. The Nitro-bacteria build up further the oxidation process by causing the HNO_2 to unite with another atom of oxygen to form *Nitric* acid, or HNO_3, and thus the highest and most stable form in the oxidation is attained. This unites with the alkalies, soda, potash, and ammonia, to form the nitrates of soda, potash, and ammonia, the first of which is found in nature in immense beds in South America and other parts of the world, and the substances which bulk largely in artificial manures.

These, briefly, are the salient facts with reference to the action of bacteria in what is now known as the Bacteriolytic or Bacteriological, or Biological method of purifying sewage.

It must not be supposed, however, that this microbic action is solely confined to this process. As a matter of fact, it plays a not unimportant part in the processes of purification by irrigation, intermittent downward filtration, or indeed in any method in which the sewage or its effluent is applied to land or filter beds. And neither is the action in abeyance in the precipitation process. But here it is more of the putrefactive character than in the other, aided to some extent by the alkaline character of the effluent, hence the sludge undergoes putrefactive change, and is apt to become offensively odorous.

One of the important questions which has arisen in connection

with the bacteriological treatment is, In what way might the particular character of a sewage interfere with the due action of the microbes? This doubtless arose from the well established fact that bacteria generally do not thrive in an acid medium, but multiply most freely in media slightly alkaline. It is well known that many trade effluents are highly acid, and therefore in a case where these bulked largely in the sewage of a particular town or centre, it was *a priori* considered that a slightly acid sewage would prevent the full bacteriological activity, and therefore the sewage would not be efficiently purified. This question can only be decided in relation to the sewage of any given place, and must be based upon the consideration of the composition of the sewage with respect to the relative proportion of trade sewage to ordinary domestic sewage. In most cases the latter sufficiently preponderates to neutralise the acidity of the former, and hence up till now, in practice, no sewage has been found which is not capable of being purified by the bacterial system.

It has been boldly stated that the results obtained from the Exeter installation were no fair criterion of the purifying effect of the bacteriological system, inasmuch as the sewage treated there was of an exceptionally dilute character, and was, in the main, composed of domestic sewage from a residential population. And it was suggested that it would probably fail if the sewage to be treated were more concentrated, and contained a considerable proportion of trade effluents. Since these things were said, however, the process has been used under conditions which entirely conform to the latter conditions, and the results have proved quite satisfactory. In short, at Yeovil, where these latter conditions prevail, the experimental installation was proved to be effective, and the sewage of this place is termed "an exceptionally foul one," consisting chiefly of manufacturing refuse from glove works, dye works, tanneries, and the refuse from fell-mongering works, breweries, etc.

In the installation at Barrhead the trade effluents do not constitute any part of the sewage, although storm water is included, and for which special provision is made up to two-thirds the requirements of the English Local Government board. Of these works generally, it may be said that they were constructed to serve a population of 10,000 persons, and to deal with a maximum flow of 400,000 gallons per day, the dry weather flow being reckoned at half that number of gallons. It may thus be supposed by some

that since storm water is admitted to the system, it will be ruinous, because of the increased rapidity of the flow, to the bacterial processes which go on in the septic tank. But, as a matter of fact, with a velocity at the rate of 600,000 gallons per day, the velocity in the tanks would only be $1\frac{7}{8}$ inches per minute, and with a velocity at the rate of 1,200,000, $3\frac{3}{4}$ inches per minute, either of which velocities would be incapable of disturbing any solid matter which may have collected at the bottom of the tanks.

From repeated examinations of these works, I have no hesitation in stating that they act in a highly efficient manner.

In the purification of sewage, one of the interesting points which has occupied the minds of scientists is, What is the fate of those pathogenic organisms—those which produce the specific infective diseases—in purification systems? Are they destroyed in the fierce struggle for existence amid the myriads of microbes which are found in the sewage, or Do they survive? Speculation answered that they must succumb. But exact scientific research has proved beyond a doubt that in the *bacteriological system* even, certain well known organisms of this type survive readily the whole process, and may be discovered in considerable abundance in the effluent. Dr. Houston, who has been conducting experiments on a very extended and extensive scale for the present Commission on Sewage has clearly pointed out in papers, founded upon these experiments, and published in different leading medical journals, "that it is doubtful if any bacterial process in practical operation at the present time, 'treats' or 'detains' the sewage for a sufficiently long period to allow of the complete destruction of all the pathogenic germs by bacterial agencies."* And he has shown these results, not from laboratory experiments, but from the actual working of the bacterial system at Barking and Crossness, in which he further points out that in respect of two, at least, of these pathogenic organisms—*B. Coli* and *B. enteritidis sporogenes*—they "are nearly as numerous in the effluents as in the crude sewage."

Indeed from his researches† he concludes as follows, on this point:—"Although the total number of bacteria, the number of spores of aerobic bacteria, and the number of liquefying microbes was, on an average, less in the effluents from the coke

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* *B. M. J.*, Vol. II., Aug. 18, 1900.

† *Edin. Med. Journal*, Feby., 1901.

beds than in the corresponding samples of crude sewage, the reduction was not well-marked, and in some cases, the effluents contained more micro-organisms than the sewage before treatment. Thus, while the chemical results were always satisfactory the bacteriological results usually were quite the reverse, because the microbes producing the chemical changes passed through the coke beds in practically unaltered numbers."

I am able personally to corroborate these results from an investigation which I recently made of a bacterial system as applied to one of our southern Scottish towns, in which no septic tank is used in the system, but, instead, the open scum-covered settling-tank, and contact-bed treatment. In the effluent, and in the stream into which the effluent passes, and in the mud of the stream—fully half a mile from the works, I found the above-named micro-organisms in very considerable numbers. These organisms, it must be remembered, are characteristic of sewage, and, moreover, are always found in the intestinal tract of man.

Respecting the organisms of Enteric Fever and Cholera—*B. typhosus*, and *B. Cholerae Asiaticae*—the same has not yet been proved to demonstration, owing to the exceeding difficulty of finding and isolating them by reason of their comparative absence from sewage, unless upon exceptional occasions. Moreover, it may be said of them, subject to further research, that they are less hardy and resistant than the others named; and from experiments that have been made by Andrewes and Lewes in 1894,* it seems well-established that ordinary sewage does not constitute a congenial medium for their life and growth; indeed, in the best circumstances their life in sewage is limited but to days—a sufficiently long time, however, to enable them to be carried by an effluent for some distance, and to cause mischief if perchance they should pollute a water-supply. If, however, we may form a judgment on this point by comparing the behaviour and vitality of some organisms, which, in usual circumstances, are comparable in respect of hardiness or delicacy with *B. typhosus*, and *B. Cholerae*, and find that some of these—such as streptococci—are abundantly found in effluents from bacterial beds, we may legitimately infer—although it is but mere inference—that the enteric fever and cholera bacilli will also survive the treatment and pass by the effluents.

* "Observations on the Bacillus of Typhoid Fever and it Relation to Sewage," *London County Council Report*, 1894.

Tempting as it is, it is practically impossible for me, at this time, to discuss the various modified methods of Bacteriological treatment which have been introduced during the last three or four years, or the details of them or their range of applicability. Many interesting points could be brought out in the discussion of the Candy System of the International Purification Syndicate, which is in operation at Reigate, of the Continuous Bacterial Filter of Stoddart as carried out at Bristol, or that of Lowcock. Neither is there time to deal with systems associated with the names of Ducat, Whittaker, and others, nor to consider the bacteriological experiments at Leicester, Manchester, nor the contact bed experiments which are being conducted at present at Dalmarnock Works by the Corporation of this city. These must be left for another occasion.

X.—*Taxation of Land Values* (*Second Paper*).

By JOHN A. TODD, B.L., Writer, Glasgow.

[Read before the Economic Science Section, 30th January, 1901.]

Two years ago I had the honour of reading a communication from this Section to the Society on the question of the Taxation of Land Values.* That paper was in effect a criticism of what has come to be known as the Glasgow Bill, which was the first, and at that time the only attempt to reduce to concrete form any of the various proposals that have been made on the subject. My endeavour then was to show that the proposal contained in the Glasgow Bill amounted to nothing more nor less than an attempt to introduce by a ten per cent. instalment the principle of the appropriation of Land Values without compensation to the present holders.

That paper was written under the impression that the proposal embodied in the Glasgow Bill was the matured form of the ideas of the land reformers in Glasgow, including those who are known as the single taxers, but it appears that that assumption was to some extent incorrect. Since that time further opportunities have arisen of discussing the whole question of land reform with many persons of different views, and particularly with one prominent exponent of the Single Tax doctrines in Glasgow, and as a result of these discussions I wish now to set down, as fairly and accurately as possible, what appears to be the real position of the Single Taxers in this country, and to consider at some length a modified form of one of their proposals, which seems to come more within the range of practical politics than that of the Glasgow Bill.

The aims of the Single Taxers may be represented in three stages, thus:—They desire

(1.) To place taxation of some kind on vacant land, especially within the boundaries of a city like Glasgow. The value of such

* Read before the Society 22nd March, 1899, and printed in Vol. XXX. of the *Proceedings*.

land, it is said, is rapidly increasing, owing to the expansion of the city and the municipal expenditure, but under the present system of taxation on actual rental, it pays taxes upon only the most trifling value, or none at all.

(2.) To alter the whole basis of the present system of taxation on property, by placing a separate valuation on ground, as distinguished from the composite value of ground and buildings, and assessing landlords' taxes upon this new land value, the aggregate amount of the taxation being in the first place the same as under the present system.

(3.) Having secured the second point, to increase the landlords' taxes gradually, until the whole 20/ in the £1 is taken, by which time it is assumed that the amount so raised would meet the whole fiscal requirements of the city, and render all other taxes unnecessary. This is the true Single Tax.

It is the first of these proposals that I wish to discuss now as a possible solution of the most acute phase of the Land Question, but before doing so, let me indicate my attitude towards the other two. The third and last is in effect just the principle of the Glasgow Bill, and as such is open to all the objections urged against that measure. To place increased taxation on land owners, without a corresponding increase of taxation on other classes of the community, is simply to appropriate land values, and to do so without payment of compensation to the landowners is pure confiscation. It may be that the private ownership of land is not a benefit to the community, but this is not a remedy that would commend itself to my ideas of justice.

As regards the second proposal, it is interesting to notice that this was the form in which it was originally carried in the Town Council, and the instructions first given to the sub-committee who framed the Bill were to give effect to this scheme. But that sub-committee, after several trials, gave up the attempt as impossible, and the Glasgow Bill, in its present form, was the only alternative they could offer. That is hardly surprising, for the task of drawing a Bill to give effect to the proposal in question would certainly not be an easy one. It would involve the worst difficulty of the Glasgow Bill to which attention was drawn in my former paper, that of placing a separate valuation on the ground on which a block of buildings stands. Apart from that, however, it is open to question whether much advantage was to be gained by the proposal, if it had been carried out, *assuming always* that the

aggregate amount of taxation imposed upon this new basis was to be no more than that levied under the old system. If, on the other hand, it was desired only as a means towards the attainment of the third proposal—the real Single Tax—then it seems to me purely objectionable.

But one cannot help being more favourably inclined to the first proposal, which is based upon what has always been the strongest argument of the land reformers, the theory of the Unearned Increment. That argument is to the effect that in and around every growing city like Glasgow, there are areas of land which might be made available for building purposes, but which are not yet built upon, and therefore, under the present system, pay practically no taxes. This land, it is said, is "held up" by the superiors or owners, who decline to feu or sell it except at rates much above its present value, because they know that with the expansion of the city the value of the land will in course of time rise to the figure which they have set upon it. It is argued that the increased value of this land can only be due to one of two causes, either (1) the expenditure of city rates upon it, or upon adjoining lands, as for instance in the laying out of parks, streets, sewers, and improvements of all kinds, in which case it is clearly no more than right that the land should bear its share of taxation for these purposes, or (2) the increased value is due merely to the aggregation of a large population around the lands in question causing an increased demand for housing accommodation. As this increased demand cannot be met owing to the withholding of the necessary land, rents are forced up to an abnormal height, thus enabling these superiors ultimately to obtain the abnormal ground values they seek. It is said that in these circumstances the increased value is an entirely unearned increment to the landowner, and ought to go instead to the community whose presence creates it. This argument, if sound, would seem to justify the complete appropriation of such increased value, if any practical scheme could be devised to effect that, but in any case it apparently follows, that to subject the present value of such land to owners' taxes, the same as are imposed upon other heritable property in the city, is the least that ought to be done.

So far as the facts are concerned, there seems to be a considerable amount of truth in this plea. It cannot be denied that in many parts of the city land has been held up by superiors until they got their own price for it, and that without their contributing anything

to the increase, and this is still going on, though probably to a very much smaller extent than it was say ten years ago.

In these circumstances the remedy proposed by the Single Taxers was to put special taxation on such vacant land in the form of a new tax on ground values, but that is not the plan I offer for consideration. I wish to put forward a modified proposal, suggested to me by a Bill presented to Parliament early in 1900.* It is to the effect that where any person holds land available for building purposes, but not actually built upon, the land, so long as it remains unbuilt, should be entered in the valuation roll, not as at present at the actual rental drawn from it, which is merely nominal, but at a reasonable feuing value, and that the owner of such land should pay owner's taxes on that value.

Throughout all the discussion provoked by my former paper, I found the idea forming in my own mind that in some such comparatively reasonable scheme as this lay the true answer to the revolutionary proposals of the Glasgow Bill. Experience of many discussions has convinced me that it is the arguments in favour of such a proposal as this that have gained for the Glasgow Bill, and the agitation underlying it, a great measure of the support they have received. There are many thoughtful and fair minded persons who would not for a moment entertain the extreme idea of appropriating land values, but who are so much impressed with the reasonableness of, and the necessity for, some such reform as this, that they have given their support to measures like the Glasgow Bill, without perhaps appreciating their real significance, or it may be with the idea that, by putting forward such extreme measures, some other more moderate scheme would be evolved. To such men the plan now put forward would come as a welcome relief, and it therefore deserves careful and impartial consideration.

The main arguments in favour of the proposed reform have already been indicated in outline. They are really so familiar that there is no need to state them more fully. It will serve the purpose better to direct attention to a number of possible

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* A Bill to amend the Lands Valuation (Scotland) Act, 1854. (Prepared and brought in by Mr. M'Crae, Mr. Bryce, Mr. Hedderwick, Mr. Colville, and Mr. Wason.) Order by the House of Commons to be printed, 2nd February, 1900.

objections to the proposal, and in doing so one thing at least becomes clear, that whatever these objections may be, they are in all cases much less serious than those which presented themselves on a consideration of the Glasgow Bill.

It will be convenient to take the various objections to the proposal under three heads:—(1) Would it be equitable? (2) Would it be practicable? and (3) Would it be effectual?

As to the equity of the proposal there is really not very much to be said. Assuming the facts—(1) that the land in question has increased, and is increasing in value, merely in the natural course of events, and without any effort on the part of the proprietors, and (2) that there is a demand for this land for building purposes, which cannot be met owing to its being held up by the superiors—on these assumptions there is no question as to the desirability of the reform. But it is just in these assumptions that difficulties will be found.

For instance it may be true generally speaking, that the value of land round Glasgow is rising, and the same may be said of every thriving town where increasing industry demands increased accommodation. But that proposition is not universally true of all the burghs in Scotland, nor of our own city in particular. Even in Glasgow there are plots of vacant ground for which the owners have paid as much as, if not more than, its present value. In these cases the proposed taxation would undoubtedly be a hardship, an extra burden which was not in view when the ground was bought, and for which there is no compensation by way of unearned increment. But in Glasgow at least it is questionable whether these cases are sufficiently numerous to render the proposed reform undesirable. It is probably true that the majority of the owners of vacant land in Glasgow have held it for some time, and have profited by the holding in respect that the land is now worth more than they paid for it. That being so those who are the exception must suffer; there is no reform possible without injury to some individual interests.

Again under the second assumption there lies a difficulty. It is certainly not the case that all the vacant land in Glasgow could be feued off and built upon *at once*, no matter at what price it was offered. To impose an immediate tax on the whole of that land at its full feuing value would therefore be unfair, because it would amount to taxation upon a value which the superiors could not possibly realise without the lapse of a considerable time. It would

be contrary to the whole principle of the argument, which is that the taxation is to be upon a value presently obtainable, but not taken advantage of. Of course it will be argued that the superiors have had time enough in the past to feu all their land, but I do not think that argument is applicable. A reform such as this, introducing an entirely new principle, should not be made retrospective. To prevent hardship it would accordingly be necessary to keep this point in view, either by placing the valuation at a pretty low figure for a few years at first, or by graduating the tax over a corresponding period, something like twenty-five per cent. of the valuation being made subject to taxation for the first year, fifty per cent. for the second, and so on.

There is, however, another objection which would probably be strongly urged against the proposal. It is undeniably a departure from the principle which has hitherto been the basis of our whole valuation system, that value should be estimated, not according to any potential, future, or hypothetical return, but according to actual value received, the actual rent paid by the tenant for the use of land or buildings, or if they are in the possession of the proprietor himself, the value which he might reasonably expect to receive from a tenant if he chose to find one. But after all, is it really such a very serious departure from that principle? Keeping in view the assumption that these lands could be feued if the superior were willing to accept their present market value, is there really any radical difference, as regards ability to bear taxation, between one man who gets a certain present value out of his property, and another who could get it if he liked, but prefers to do without and wait till he can get more? Conceive, if you can, of the case of a landlord of many houses who, not content to accept fair current rents for his property, resolved to let all his houses stand empty rather than let them below the figure at which he was aiming. I fancy he would not long be allowed to enjoy the privilege of an empty house in regard to immunity from rates. Such a case is, of course, absurd, because the life of a house is comparatively short, and the capital expenditure upon it large, so that it must be kept in constant occupation to yield a return, but on principle there is a possible analogy between the two cases.

On the whole then it may be said that, as regards the abstract justice of the proposal, the arguments in its favour outweigh those against it. Turning now to the practical objections, these will be found rather more troublesome. First of all there is, in a modified

form, the old objection which was so strongly urged against the Glasgow Bill, the difficulty of setting a building value, as it might be called on unbuilt ground. But even on this point the difficulty is certainly very much less than it was in the former case, for various reasons :—(1) It is not nearly so huge an undertaking. The Glasgow Bill would have required a valuation of all the ground in the city, whether already built upon or not. The present project would only require a valuation of the ground still remaining vacant, the total amount of which is not so very large. Further, the valuation under the Glasgow Bill would have been a permanent institution requiring constant revision. Under this scheme it would only last till the land was all feued off and occupied by buildings. (2) It is not so utterly impossible to find any data to go upon as in the former case. Here the question is comparatively simple. What is the present feuing value of the land? Most of the land in question is not in the centre of the city, but in outlying and semi-suburban districts where there is always a certain amount of feuing going on, and this would help towards the formation of a fair idea of its feuing value. (3) The principle of the valuation would not be any fanciful idea as to the best possible use to which the ground might be put, but simply a matter of fact calculation. What could the owner of this ground get for it if he put it up for feuing and accepted the highest offer? (4) The land being mostly in considerable lots, it would be possible in many cases to make an average calculation for the whole of one large plot or estate, making allowances of course for front sites, corner sites, and so on. (5) In the case of large urban estates, such as say the Dennistoun Estate, the criterion of value would be ready made. These estates are already laid off with a view to feuing and the feuing prices are all fixed, and this value, which the proprietors of these lands are presently asking from feuars, would presumably be taken as their fair value. I do not think you would find any of these proprietors willing to admit that they are asking any more than the fair present value of their land.

One shorthand method used to be suggested as a way out of this difficulty of valuation,—that the proprietor should be allowed to place his own valuation on the land, but to prevent undervaluation he should be compelled to sell his land to anyone who cared to buy at the price named. But that scheme is hardly to be commended as a real attempt to meet the difficulty. It is merely a rather cowardly shifting of the difficulty from the

shoulders of the Assessor to those of the owner who is probably much less able to form a correct opinion of the value of his land. It would place the landowner on the horns of a cruel dilemma. If he undervalues his land, he runs the risk of having it taken from him at that value. If he overvalues it, he must pay taxes on the excessive va'ue. Even if he happen to strike the exact market value, he is liable to have his lands taken from him compulsorily without compensation. This scheme therefore has nothing to recommend it. To make it feasible at all it would require to be modified by the addition of say ten per cent. to the value of the land as compensation for compulsory purchase, the same as is done by Railway Companies.

In any case, however, it is very questionable if there is any necessity for such a method of valuation. In spite of the admitted difficulties of the que tion, I think it may confidently be said, that a reasonably fair valuation *could* be made of all the vacant land in Glasgow at the present time. I know a builder in the southern district of the city who tells me that he could quite easily estimate the fair value of any piece of vacant ground in his own district. He knows the situation of the ground, he knows what kind of houses are wanted in that district, he knows how many houses of that kind could be put upon the ground, and what it would cost him to do so. He knows what demand there is for such houses in the district, and what rents he would be likely to get for them, and from these figures he can make a fairly accurate estimate of what he could afford to give for the ground, and that he would say is its fair feuing value at the present moment. The same might be said of any other district. Those who know the district can give a very fair idea of the present feuing value of any vacant building land in their neighbourhood, and that would serve the purpose well enough.

We come now to the last question. Would the proposed reform be effectual? It is to be feared that of all the three questions this will be the least easily answered in the affirmative.

There is, for instance, the difficulty of framing a Bill free of technical defects, such as would allow of the process commonly known as driving a horse and cart through it. It may appear an easy matter, knowing what is wanted to be done, to frame a Bill to do it, but that is a great mistake. It is not an easy matter to put into accurate form so complicated an idea as this. Take, for instance, the definition of vacant land. This must provide a

criterion which will define and limit the class of land to which the Bill is to apply. It must bring out the following points :—

(1) The land must be "available for building," *i.e.*, it must be possible to say that it could within a reasonable time be feued for building purposes at a certain price. To ensure this, two things are necessary. The land must be ready for feuing, it must be in such a position and condition that, in the event of feuing, certain of the comforts of civilization, which are now regarded as necessaries, would be obtainable, *e.g.*, facilities of communication, gas and water supply, and efficient means of sanitation. Further, there must be an excess of demand over supply for building land in the district, and such an excess as would require at least the amount of the land in question to meet it.

(2) The land must be at present vacant, or it must be occupied only by buildings of a temporary nature or of trifling value, or otherwise it must be yielding an actual return less than the potential feuing value.

Let us attempt to embody these points in a definition. "Vacant land shall be deemed to be land available for building purposes which is at present unoccupied by any buildings, or is only occupied by buildings of which the actual yearly rent, in terms of the Valuation Acts, is less than the reasonable feuing value of said lands. In ascertaining whether land is available for building purposes, the Assessor shall consider the nature, condition, and position of the land, and the extent of, and the demand for such land in the district for building purposes."

The difficulty is even greater when we attempt to put into legislative form the principle by which the Assessor is to be guided in estimating the reasonable feuing value of the land. It has been indicated that the only fair principle of valuation is that of an offer actually made and refused, or at least a value actually obtainable but not taken advantage of. The following may be suggested by way of reducing that to a definition :—"In assessing the reasonable feuing value of any vacant land, the Assessor shall, as far as possible, be guided by any particulars known to him or otherwise obtainable of any offer made by an intending feuar for land of a similar class, or similarly situated, in the same district as the land under valuation, whether such offers have been accepted by the proprietor of the land or not."

But assuming that these difficulties have been overcome and satisfactory definitions arrived at, it is to be feared that the administrators

of the Act would not yet find their troubles at an end. Even with the most careful framing, it would not be impossible for an expert conveyancer to raise technical questions under the Act. For instance, a possible question might be suggested as follows;—Under such a definition as has been indicated, the proprietor of a large plot of vacant ground, say the space between four streets on a feuing plan, would be entitled to have the whole plot valued as one piece. Now, if he could by some means get part of this plot, not feued off or sold to another person, but yet occupied by valuable buildings while remaining in his own possession, if, for example, he built a tenement of dwelling-houses upon one corner of it himself, that would probably be of sufficient value to withdraw the whole plot from the category of vacant land. The proprietor of a large feuing estate might thus erect one tenement on each square plot of ground on his feuing plan, laying out the remainder of each plot in garden ground for that tenement. By doing so, he would probably get such excellent rents for the houses in that tenement, that the total rental would exceed the feuing value of of the whole plot, and so he would escape the taxation altogether. I do not offer this seriously as a thing likely to happen, but it may be taken as an instance of possible schemes for evading the proposed taxation. The serious point of it is, that if a superior is able to get round the Act in some such way as this, he has once more the whip-hand, and can lie bye again until the feuing value of his ground rises higher than ever to recoup him for his extra outlay.

Apart, however, from such technical difficulties as these, there remains to be considered the broad question of whether the proposal would have the desired effect of bringing land into the market at reduced feuing rates, for that I take it is the real object of the proposal, more than any possible increase of the fiscal revenue.* It is of course a question of fact upon which no one should dogmatise, and the presumption certainly is that its effect would at least tend towards that. But there is an element of doubt in the fact that landed proprietors, especially those who indulge in the expensive luxury of holding up their land, are generally wealthy

* I mean that this is the real object of the Land Reformers, but not mine. I put forward this proposal, not so much as a means of forcing land into the market, nor yet of obtaining increased revenue from taxation, but primarily as an attempt to remedy what seems to me a real defect in the present system of valuation and assessment.

and are quite able to continue holding up, even in the face of taxation. Besides, it would probably be possible for them to lighten the burden of the taxation by encouraging tenants of a temporary nature, *e.g.*, woodyards, coal sheds and the like, from which sufficient rental could be drawn to cover the taxation, and it is very doubtful whether such a state of matters as that would be an advantage to the community.

But a much greater danger to my mind is that the proposed taxation might have a serious effect in doing away with the feuing system altogether, by the introduction in its place of the Leasehold system which holds good in London and elsewhere in England, and even in some parts of Scotland. Builders would in time get used to working on 99 years' leases, or even shorter, and the profit to the proprietor of the land would be all the greater in the end. It should be remembered that a feuing rate which seems high just now will probably seem low, fifty or a hundred years hence, and it would pay the superiors far better to accept a comparatively small ground rent under a Lease for such a period, and have the ground and buildings falling into the estate again at the expiry of the lease. The development of such a system in Scotland would be a calamity far greater than any possible evil of the present system.

In view of all these difficulties and objections it will probably be asked whether this project is really worth anything at all. The question seems natural, and it becomes still more pressing when it is borne in mind that it would be necessary, in the first place at least, to impose certain limitations on the scope of the reform, which would seriously diminish its usefulness. For one thing it would be advisable to confine the proposed Act to Burghs. There is no doubt that by doing so it would fall short of its greatest need, which is to touch the unearned increment of the vacant lands all round but not within, a city like Glasgow; but to extend the Act to cover such land as that would raise a number of other difficulties compared with which those already considered would be mere trifles. To go no further it would increase the magnitude of the task of valuation a thousand fold, and it would also add greatly to its delicacy and difficulty, especially in dealing with the marginal circles round populous centres, where the excess of building value over agricultural value is tapering off to zero.

Again it would follow from the limitation to Burghs, that the proposed new Valuation should be used only for local taxation in

these Burghs. One is apt to forget that the Valuation Roll in its present form is the basis of assessment for Property Tax, the only Imperial Tax which is so levied. It would not be fair to increase the burden of Imperial taxation in the Burghs without a corresponding increase over the whole country. Some method would accordingly require to be adopted which would give effect to the new valuation for purposes of local taxation, without interfering with the existing form of the Valuation Roll, which would still remain the basis of Imperial taxation. The best method would probably be to provide an extra column for the valuation of vacant land.

Yet with all these limitations the proposal merits serious consideration. It would certainly require a great deal of adjustment, and at the best the Act would not be an easy one to administer, but the experiment is worth trying. It would be a valuable object lesson and the experience gained would repay the trouble. It is possible that the difficulties outlined might prove less formidable in practice, than they seem in prospect, and experience might encourage us to extend the scope of the reform, by removing in course of time the limitations I have spoken of. In any case it could hardly fail to bring us appreciably nearer a solution, in one way or the other, of the worst difficulty of the land question, which to my mind is the question, whether it is possible to make an effective valuation of land apart from buildings.

I believe the proposal deserves a trial for this reason if for nothing else, that it would go far to meet the views of those who desire a certain measure of land reform, but, like myself, are totally opposed to any such reform which means appropriation without compensation. I cannot hope that it would be accepted by the extreme section of the Land Reformers as anything but the first step towards their object, but it might help to show them that a great deal of good could be done, without the extreme measures which they at present think necessary, and so it might conduce to the ultimate settlement of the question of Land Reform, which I believe will come in the end without appropriation.

Note.—In view of the discussion which followed the reading of this paper I would add that I put forward this proposal with the intention of eliciting discussion, and tried as impartially as possible to state not only the arguments in its favour, but also the practical difficulties which were likely to arise in putting it into force. I

had hoped that some of these difficulties might be minimised, or means suggested to overcome them, but instead of that they were exaggerated and added to. Nevertheless I still think that though that may be the result of the discussion the matter deserves attention. I submit that this proposal contains all that is good in the Land Reform agitation, and it is well that it should be known that in the opinion of many, friends and foes alike, that little all is impracticable. But I must confess that even yet I do not altogether share that opinion.

XI.—*Trusts and Combines.* By JOHN GALLOWAY.

[Read before the Society, 17th April, 1901.]

As some of you are aware, in September last I addressed the Glasgow Chamber of Commerce on Combines and Trusts, and in doing so I met with a good deal of opposition, not so much on the merits of the question, but because some of the Directors thought that the time was inopportune—that the question could only be dealt with in an academic way, and because it was a subject with which a Chamber of Commerce had nothing to do. I am glad that this Society looks upon this most important subject in a different way, and are willing to discuss it upon its own merits; and indeed it would be difficult to name a commercial question at the present time which is more practical or deserves more serious consideration than that which is upon your programme to-night. We are passing through a vast commercial crisis, different from any we have hitherto been called upon to face. Other crises have come upon us in the past with disastrous effects, driving men into the bankruptcy courts, and telling sometimes with most ruinous effects upon our working classes. Such crises, however severe they may have been, were only temporary, and soon passed away. The crisis, or to speak more correctly, the revolution we are now considering, has come in velvet slippers, so that you can scarcely hear its tread; but its effects for good or evil are far-reaching, and are bound to be felt by generations yet unborn.

I perfectly understand that this paper is simply to be the prelude to a discussion upon the subject, and in consequence I have made it as briet as possible; and if any of the gentlemen present think that I have not given the prominence to the various aspects of the question which they deserve, I trust they will understand that it is not for want of material, but simply out of regard to your time.

Combines and Trusts I will consider as one and the same thing. The American Trust at the first had features quite distinct from the Combine. These, however, have become so modified

that I consider that for all practical purposes, and especially in such a discussion as we purpose having to-night, they may be regarded as one. I will use the word Combines, and it will be understood that when I do so Trusts are included, excepting when I differentiate between them.

These Combines then have been called into existence from three distinct causes. 1. In order to do away with ruinous competition. 2. To economise cost of production so that a greater profit may be realised. 3. That proprietors of commercial enterprises may be able to pocket sums greater or smaller in the name of stock or goodwill. Sometimes one of these reasons has been the moving cause, sometimes a combination of two or even of the three.

Looking at them one by one there appears nothing objectionable at the first look in the composition of any of the three. They each embody sound commercial principles, and indeed, especially in dealing with the first, namely the desire to do away with ruinous competition; no one who knows the history of commerce in our own and other lands in the immediate past, but can readily understand that some such arrangements may have been in many branches of trade necessitated by the extreme pressure brought to bear upon them by undue competition.

I wish therefore to make it plain that I am not against Combines, as such, and I am all the more anxious to do so because, although I thought I had made my position quite plain when I addressed the Chamber of Commerce on the subject, many of those who then heard me failed to comprehend what my position was, and considered I was against all Combines root and branch. I wish, also, at this stage, to say that Combines have come among us to stay, and I can conceive of no power, legal or legislative, capable of destroying them; and of course if we are to be practical in dealing with them this must be taken into account.

But whilst all this is freely admitted, most even of the firmest advocates of Combines at once concede that there are many evils connected with them, and it is only reasonable that these evils should be carefully examined, and measures taken for the purpose of having them eliminated, or rendered as innocuous as possible.

And in making our inquiry we are compelled to turn to the United States, which may be regarded as the birthplace of this system, and where it has flourished as it has done nowhere else, in order to learn many lessons. I am perfectly aware that in this country, with free trade as an important factor, some of the evils

cannot attain the magnitude they have on the other side of the Atlantic; but whilst admitting this, there are many things of practical importance to ourselves, and from which we may learn important lessons. In that land of tremendous energy and mighty progress, Combines have like a gigantic octopus seized well nigh upon every industry; they permeate all enterprise, and make their presence and power felt in the remotest parts of the land. It is calculated that already 90 per cent. of the trade of the States has been brought under their influence, and the process is by no means complete; and when the remaining 10 per cent. has been drawn into the vortex, it is hard to tell what will happen; possibly like the Kilkenny cats they may take to eating one another.

And as one dips into the subject, it is passing strange to find the unthought of forms many of these Combines take, and the multifarious trades they embrace. We all know about the great Oil Trust—the Steel Trust, in which Mr. Morgan and Mr. Carnegie have figured so prominently; and there are some of the other concerns whose names have travelled across the Atlantic. But these convey but a poor idea of the tremendous hold this system has upon the trade of the United States. Let me give the names of a few of these Combinations:—

The School Board Trust, for supplying school books.
The Carpet Trust.
The Candy Trust—we would call it the Sweetmeat Trust—with a capital of no less than £15,000,000.
The Celery Trust, for supplying the market with vegetables.
The Flour Trust,
The Butcher Meat Trust.
The Fruit Preserving Trust.
The Farm and Dairy Trust.
The American Ice Trust.
The Window Glass Trust.
The Bicycle Trust.
The Writing Paper Trust.
The Billiard Table Trust.
The Bag and Paper Trust, for supplying shop-keepers with paper bags.
The Theatrical Trust.
The Cab Trust.
A Fish and Oyster Trust.
A Sardine Trust.

These are but a few out of an endless list of names, and it is calculated that in the United States no less a sum than £2,000,000,000 is invested in these various Combines, so that every one will readily understand the tremendous power they exert; and this power is used unscrupulously to hinder any legislation which they deem to be detrimental to their interests from being carried out as well as to prevent any rival from interfering with the monopoly they have secured.

I have given these particulars because there is nothing in the peculiar conditions of trade in this country to prevent similar combinations being made here, and the necessity that exists for action being taken ere a power is acquired by such as will make remedial measures impossible at a later stage. When we turn from America to our own country we find that the system has taken root amongst ourselves. Had I time, I could read you a list of British Combines with their capital which would probably astonish most of those present. Ten of these Combines, whose names are well known, and they are not those with the largest capital, have yet capitals amounting in the aggregate to £56,000,000; and the number is being constantly added to.

And now we come to the evils connected with such enterprises, and the one which stands out head and shoulders above the others is the monopoly and the tremendous power which passes into the hands of these Combines. Personal freedom is thus interfered with and individual enterprise and initiative becomes an impossibility. No ordinary opponent can ever hope to succeed in the face of such vast organisations They have the power to crush every weak adversary to the wall, and such both in America and here has been the case.

Now it is an admitted principle that wherever monopoly prevails the State has a right, and in many cases is bound to exercise a controlling power, or enact laws which shall prevent such monopoly from doing damage to the community. Accordingly we find that Railway Companies, Gas Companies, Telephone Companies, Banks, etc., have been placed under stringent laws and strict State supervision; and as the monopolies which we are considering are more dangerous in the possibilities of the misuse of the practically unlimited power which they possess, there is a greater call for the exercise of this power. Later on I shall endeavour to show the directions in which this controlling power

may be exercised, and indeed some of the promoters of Combines in this country have recognised the reasonableness of such interference. The great Coal Combine which was attempted to be formed a few years since in this country with a capital of £120,000,000 had for one of its articles that its profits should never rise above 15 per cent. excepting with the consent of the Board of Trade. This principle has also been freely recognised in the United States, laws innumerable have been passed against Trusts; but owing to want of unanimity among the various States, the peculiar constitution of that country and the vast power attained by the various Trusts and Combines, these laws have proved hitherto inoperative.

Another evil is the power which these Combines have of controlling the markets of the raw materials which they require. It can easily be understood that where a large Combine is the only, or by far the largest purchaser in the country, the temptation to squeeze the market is great, and a tyranny may be exercised which in another form will repeat upon others the evils of inadequate profits which the Combine was formed to save its proprietors from. In America, where the system has taken such hold, this is by no means an ideal evil, and if it is but lightly felt among ourselves, I fear it is merely because it is not fully developed. President M'Kinlay has said that combinations which control the markets of any commodity to suppress natural competition are abnoxious, not only to the common law but also to the public welfare. President Harrison has declared that Trusts were dangerous conspiracies against the public good, and should be made the subject of prohibitory and even of penal legislation.

This power may be exercised in still another way; let me give a concrete case to shew what I mean. The Master Dyers of the West Riding of Yorkshire entered into an agreement with the Amalgamated Society of Dyers and the Gasworkers and General Labourers' Union; this Combination at once included 60 per cent. of the employers and 90 per cent. of the employees. They then proceeded to force those dyers who had held aloof to join, and they did this in the most high-handed and unwarrantable way, namely by calling out their men and bringing their works to a standstill; and finally a system of fining was established for breaches of agreement both for masters and men. The employers were bound to engage only those men who belonged to the Union, and the members of the Union bound themselves to work only

for the amalgamated masters. In this way the system was perfected by which opponents could be squeezed out of existence, the outcome being a tyranny unknown previously in this country.

There is still another manner in which this power may be exercised—viz., by controlling the rates of freight either by land or sea. A Shipowner or a Railway Company in order not to lose a large customer may give such special rates as will give the Combine a most unfair advantage over its weaker opponent. This has been a most tremendous evil in America, and possibly the well known Oil Trust in which Rockefeller is the moving spirit, is the greatest sinner in this connection. Allow me again to give an instance, this time from America, to show to what extreme lengths Combines and Carrying Companies may exercise the all but unlimited power they possess. The report of the United States Commission gives it and it is quoted by Mr. Crewdson in the excellent address he delivered to the Chartered Accountants Students Societies of Glasgow and Edinburgh.

In the seventies there was an oil refiner named Rice, who had an oil refinery at Marietta. Either his opposition was being felt by the Oil Trust, or in some way he had got into its bad graces. The railway, acting in the interest of the Trust, doubled the freight on oil, and on oil only at Marietta. The Oil Trust had a refinery ten miles from Marietta, but the freight was not raised there. The railways to the Southern States, acting in the same interests, raised the rate of freight upon Rice from 29 to 212 per cent above what was charged for oil sent by the Trust, and finally they refused to give him freight at all. In addition the railways paid the Oil Trust rebates on the freight charged to Rice. They further discriminated to the extent of 199 on every 200 barrels against Rice and in favour of the Trust. Surely this rice was well ground between the upper and nether millstone of an all-powerful Trust and unscrupulous Railway Companies. But what a picture does it present of the tyranny which may he exercised, and even if it be proved that in this country things could not be carried to such extremities, still we know that unscrupulous men may go to great lengths in the same direction; and instances could be given in our own neighbourhood where they have done so.

We are all aware what a powerful impulse self-interest is in commercial enterprise, and how every energetic young man looks forward to being one day the head of some business; and the hope thus engendered spurs him on to work hard for the attaining of

the prize he has set before him. The ultimate outcome of this in the past has been to fill our land with men self-trained, self-reliant and energetic, who have been the means of raising this country to the proud position it occupies among the nations of the world.

But what are we to expect when the system of Combines has wrought out its inexorable logic of cause and effect to its legitimate end. Anything like independent action disappears, the hope of one day being the master mind controlling an independent business, vanishes, and the individual is all but lost in the vast crowd of employees of which he is but a unit, and he becomes like the boys and girls in some of our large charitable institutions, where John Thomas becomes number 263; or to use the telling language of President Cleveland it means "the displacement of the farmer, the artisan and the small trader from the proud position of being his own master, and relegating him to the level of a mere appurtenance to a great machine, with little free will, with no duty but that of passive obedience, and with little hope or opportunity of rising in the scale of responsible citizenship."

As the law at present exists there is the danger of the vendor of any concern obtaining too much for good-will, the investor only discovering the evil when it is too late for remedy. Of course this is a danger which applies to all transactions of the kind, and is not confined to Combines; only in these it is much greater than in small concerns.

It will also be apparent to all that all this leads to a most unequal distribution of wealth, especially in the case of those Combines whose shares are held privately and are not to be purchased in the open market. A comparatively small number get the golden prize, whilst the many are employed to work for it with little or no hope of rising from the position they occupy.

Still another evil exists, and this is the power possessed by these combinations when once their power is fully consolidated, of raising the price of the article dealt in to an undue figure. I am aware that in this country Free Trade gives a fairly satisfactory guarantee that this cannot be done on many articles except to a limited extent; but there are many departments of trade in which such a power can be exercised, and one has only to turn to the monopolies possessed by many patentees in order to know how readily many act out this principle.

Combines also in one important direction deteriorate the workman, in so far that instead of going through a general education

which gives him a knowledge of his trade in its various departments, he is confined to the learning of one part, and that frequently a very small one. True he becomes an expert in that one detail, but he is not the intelligent all-round man he ought to be.

The ideal at which men have been striving for long when studying the relationship of master and man has been to bring both to realise that their interests are in reality one, and where wise and kindly action has been taken this has, in very many cases, been realised to the benefit of both employer and employee. Instances could be given in our own neighbourhood where this result has been attained. I know of nothing which so thoroughly puts the extinguisher upon all such efforts as the Combine System. Managed from a centre, distant it may be from the place where production goes on, the workman becomes simply a part of the great producing machine by which profits are to be made, and the kindly interest which ought to exist between master and man, and which does so much to bind the different sections of society together, of necessity ceases.

I might say something of the great international competition in which these great Combines are such important factors, and which is likely to tell so severely upon our home, but especially upon our foreign trade; but I have already exceeded the limits I had laid down for myself, and must bring my paper to a close.

The only question to be further considered is the remedies, and in regard to these I can only repeat what I said in my address to the Chamber of Commerce; that I question if any private individual is in a position to propose such in a way which will meet the far-reaching and varied aspects of the evils complained of; protecting Combinations on the one hand in what may be their undoubted rights, and, on the other hand, protecting the public from the power of these vast monopolies. It seems to me that the proper method would be to have a parliamentary enquiry, and then when full information is obtained, to frame the needed laws.

I also gave in the speech I then delivered some of the remedies which had been suggested together with one or two of my own. These, however, were criticised as if I was wholly responsible for them. This was not the case, and I merely summarised them in order to show that legislative remedies were not so hopeless as some people think.

APPENDIX.

The following were the remedies spoken of by Mr. Galloway in the previous paper above referred to :—

1. I would suggest that a Government department be created for the special supervision of Trusts.
2. That no combination of firms or industries be allowed until the terms, objects, and probable effects of such be examined and approved by this department, and a license or notice of registration issued.
3. That no combination be approved which has for its object the obtaining of a monoply in any class of trade in the kingdom, or in any district of a given size or population.
4. That as in the case of Gas Companies the profits to be distributed shall not be above a fixed percentage.
5. That reserves under whatever name and their ultimate appropriation be under the control of the Government department.
6. That all agreements between employers and employees, such as at present obtains in the Birmingham district and in Yorkshire, where the employers are bound to employ none but Union men, and Union men are bound to serve only Amalgamated employers, be declared illegal, and subject to fine.
7. That freightage of all kinds must be the same to the independent firm as to any Combine.
8. That selling or working under cost price for the purpose of damaging a rival be illegal.
9. That any Combine which seeks, at its incorporation or by its action afterwards to obtain the control of the raw material upon which it depends, shall not obtain its license, or if it has one, be subject to heavy fine, and afterwards if this rule is continned to be broken, to lose its license.
10. In every prospectus issued at inauguration, and with regard to every amalgamation entered into after, it shall be necessary to state the amount paid for goodwill or for any consideration other than for *bona fide* assets as distinct from the issued capital of the Company.

11. That every prospectus shall be signed by a given number of individuals, who shall be held responsible for any misrepresentation made in it.

12. The Patent Laws should be altered so as to prevent these from being made the basis of monopolies.

13. If patents are held by any Combination for a given period without being exercised, they should lapse.

14. Powers should be taken by Government to acquire by purchase any patent held by a Combine for the purpose of making such public property: or it should be allowable for other firms to work such a patent on payment of a royalty to be fixed by the Government department.

It will be understood that these Rules are for the regulation only of Combines and in regard to the obtaining of a license that this rule shall not be retrospective.

EDITORIAL NOTE on the proposed reforms:—

No. 7. This is already provided for by the Railway and Canal Traffic Acts.

Nos. 10 and 11. These are already provided for by the Companies Acts, particularly the Act of 1900, passed since Mr. Galloway's former paper was read.

XII.—*The Story of the Insane—with special reference to Glasgow.*

By HAMILTON C. MARR, M.D.

[Read before the Society, 10th April, 1901.]

ALIENISTS or specialists in mental disease have a wide field for the exercise of their specialty. They consider the brain—as the organ of mind—its study and that of the body as a whole, it is almost unnecessary to say an essential part of a successful endeavour to understand mind, and the insanities of mind, so great is the interaction of the various organs of the body. Further, they must know what are the elements in the environments or surroundings essential or injurious to mental digestion.

On some prominent parts in this comprehensive domain of alienism I wish to speak to-night. Before proceeding to the subject proper, allow me to put before you, as shortly as possible, the general position in reference to the question often asked, "What is Insanity?" Lord Justice Blackburn, in giving evidence before a select committee of the House of Commons said, "I have read every definition of insanity which I could meet with, and was never satisfied with any one of them, and have endeavoured in vain to make one satisfactory to myself, I verily believe it is not in human power to do it." A dictum reminding one of the saying of Polonius, "Your noble son is mad: mad call I it, for to define true madness what is't but to be nothing else but mad."

Insanity cannot be defined, and for obvious reasons. In the majority of cases it is a relative increase or lessening of what is recognised as sanity. No accurate limits can be assigned to healthy conditions, and it cannot be said at this point precisely sanity ends and madness begins. There is no such boundary in nature. "No man," says Burke, "can draw a stroke between the confines of day and night. Yet light and darkness are upon the whole tolerably distinguishable." So it is with insanity. On the whole it is easy to tell an insane from a sane person, but many cases arise in a vague borderland, which require the experience and judgment of the alienist to determine their nature.

Into this borderland fall persons who range through the gamut of intelligence, the imbecile, the criminal, the inebriate, and degenerates of a like type, and finally the genius of whom Dryden has said—

> "Great wits to madness nearly are allied,
> And thin partitions do their bounds divide."

Joan of Arc, Napoleon Buonaparte, Socrates, Mohammed, Cowper the poet, and Dean Swift, not to enter the controversial realm that Lombroso and his disciples have opened up, all exemplify the truth of this saying.

The lot of the insane, until the opening years of the 19th century, was a hard one, housed in gaols, placed in cages, accommodated in caves and dungeons, associated with criminals, sleeping in hospitals, four or five in a bed, confined in wards with patients who had loathsome diseases, exhibited for money, incited to gorge themselves with food and filth for the amusement of visitors, dying of gangrene, from exposure to cold, or want of clothing and of food. Cared for by dissolute and immoral keepers, who did not scruple even to murder their charges, and placed in buildings where there was no separation of the sexes.

Such is the mere catalogue of the sufferings of the insane. One of their number sings—

> "The lovely lofts of Bedlam,
> In stubble soft and dainty,
> Brave bracelets strong,
> Sweet whips ding dong,
> And a wholesome hunger plenty."

St. Vincent de Paul, in the 17th century, was "the first who sacrificed everything for the outcast lunatic. He journeyed from land to land to preach and propagate the cause of charity, his mission was to bring back the sympathies of our nature to their proper channels, to proclaim that the darkened mind was as much the visitation of God as the darkened vision, that Christianity demanded of the humane, and virtuous, and powerful, to protect, and the skilful to relieve the one as well as the other." The teaching of St. Vincent de Paul was long in bearing fruit.

In 1792 Pinel struck the fetters off the patients at the Bicêtre in Paris, and began to treat them humanely. Three years later,

ignorant of what Pinel had done, Tuke, the Quaker of York, introduced to the York Retreat the same humane treatment of the insane. It was many years before the work of these individuals was recognised and imitated, but once begun a new era dawned for the insane, and in this day of enlightment he would be considered peculiar indeed who would advocate that the sick in mind should be differently treated to the sick in body.

In this paper I intend to speak mainly of the pauper insane. The use of the word pauper must be made with qualification. In our Glasgow asylums the annual cost per patient is about £27 per annum, if the patient is boarded out in the country, the cost per annum is at least £17. Most of the working class community, a class representing four-fifths of our population, are unable to pay a sum of money larger than those mentioned for their insane relatives, and cannot get them classed therefore as private patients, and placed in royal asylums. Application is made to the Inspector of Poor for their admission to the district asylum of the parish in which the patient is situated, and all patients in these asylums are classed as pauper.

Contributions for the support of the patients is levied on the relatives, and they have to pay according to their means. The parish authorities again benefit by a government grant of 4/4 per week for each patient, on behalf of whose maintenance a sum is expended equal to at least 8/ per week. No claim on government in respect of any expenditure exceeding this sum is allowable.

The term pauper, in the sense that the insane are wholly dependent on the parish, is a misnomer. It is correct in its strictly original meaning. The pauper insane are housed in asylums, or boarded out in country districts.

It will not be uninteresting to trace the genesis of both these methods of accommodation of the insane, and describe their main features.

To explain the boarding-out system one has to fall back on superstition as the fount and origin. The superstition that the insane were possessed of devils, and the attendant belief that by miraculous power they could be restored to their senses. In Scotland there was a superstitious belief in the efficacy in this respect of certain wells.

At Strathfillan, in Perthshire, there is a deep pool called the Holy Pool, where in olden times they were wont to dip insane people. The ceremony was performed after sunset, on the first

day of the quarter (o.s), and before sunrise next morning. The dipped persons were instructed to take three stones from the bottom of the pool, and walking three times round each of the three cairns on the bank, throw a stone into each. They were next conveyed to St. Fillan's Chapel, and in a corner called St. Fillan's bed, they were laid on their back and left tied all night. If next morning they were found loose, the cure was deemed perfect, and thanks returned to the saint.

As lately as 1843 the pool was visited, not by parishoners, for they had no faith in its virtues, but by people from other, and distant places.

Strange as it may appear, says Robert Chambers, the ancient bell of the chapel, believed to have been St. Fillan's bell, of a very antique form, continued till the beginning of the 19th Century to lie loose on a gravestone in the churchyard, ready to be used, as it occasionally was, in the ceremonial for the cure of lunatics. The popular belief was that it was useless to attempt to appropriate it and carry it away, as it was sure, by some mysterious means, to return. A curious and covetous English traveller put the belief to the test, and the bell has been no more heard of.

Pennant, author of a tour in Scotland and the Hebrides, says of a famous well on Inch Maree, an island of Loch Maree in Rossshire, "the curiosity of the place is the well of the saint, of power unspeakable in the cases of lunacy. The patient is brought into the sacred island, is made to kneel before the altar, where his attendants leave an offering in money, he is then brought to the well, and sips some of the holy water. A second offering is made, that done, he is thrice dipped in the lake, and the same operation is repeated every day for some weeks, and as it often happens, by natural causes the patient receives relief, of which the saint receives the credit.

It was belief similar to the faith in the healing powers of water that gave rise to the Colony of Insane at Gheel in Belgium, which is the prototype of the system of boarding-out of lunatics throughout Scotland.

In 600 A.D. St. Dympha, an Irish princess is said to have been beheaded by her father at Gheel, a village twenty-six miles east of Antwerp. Pilgrims, chiefly the insane, visited the shrine of this Christian virgin, and many were restored to sanity and serenity. But many who came to be healed remained in the care of the

villagers. Since the 7th century, the insane from all parts of Belgium, and some parts of Holland, continued to crowd to Gheel.

The Colony of Insane at Gheel is now under government regulations, and contains about 2,000 patients. The acutely insane, to the number of 400, are treated in a central hospital in the village, the remainder of the patients are boarded out with villagers and the farmers around. The whole colony is dispersed over a tract of country forty miles square. The bedrooms of the patients conform to a regulation standard, and the patients are forbidden stimulants.

In Scotland patients are boarded out in country districts with villagers or farmers. Over 2,703 pauper patients are thus accommodated at the present time. By Act of Parliament not more than four such patients may be placed under one guardian, and every guardian requires a license from the General Board of Lunacy. The patients boarded out are, according to the Deputy Commissioner on Lunacy, to the extent of seventy-seven per cent. imbecile or idiotic, and twenty-three per cent. are inoffensive patients suffering from chronic mania, melancholia, or dementia.

Many of these boarded-out patients have been inmates of asylums, who have been considered suitable as regards their conduct and demeanour, for the privileges and extended liberty of a private dwelling. They are visited annually by the Inspector of Poor, and members of the Parish Council to which they are chargeable, are under the occasional medical treatment and routine visitation of the medical officer of the parish in which they are placed, and are visited and reported on twice annually by a deputy commissioner in lunacy.

The guardians of the patients receive a sum of about 7/ a week, exclusive of a supply of clothing for each patient. Both these items are provided by the Parish Council to which the patient is chargeable. The advantages claimed for the boarding-out system are the relegation of the patient to a home in the true sense of the term, the patient being in all respects like his guardian, greater freedom for the patient, and economy for the parish.

The accompanying map shows the extent to which certain parishes board out their insane patients. It varies from forty-two per cent. of the total insane chargeable to Edinburgh Parish to

three per cent. of the total insane boarded out by Gourock. The Glasgow Parishes board out twenty-three per cent. of the insane patients.

Until 1737 no provision was made in Scotland for the accommodation of the insane. An act of 1579 describes in the class of beggars (a class exactly corresponding to those delineated by Fletcher of Saltoun, in 1698), feinzed fules or bairdes.

They corresponded to the Tom O'Bedlams, one of whom Edgar impersonates in King Lear. In the list of beggars classified in the Act of 1579, these wandering lunatics had curious associates who show the lowly condition to which literature had fallen "Vagabond schollers of the Universities of St. Andrews, Glasgow and Abirdene, not licensed by the rector or Deane of Facultie to ask almes."

The lunatics wandered about the country soliciting alms from the charitable on whom they lived. If their condition of mind was that expressed in the following stanza of one of their mad songs published by D'Israeli, the lot of these wanderers was certainly happier than that of their less fortunate brethren housed in asylums.

> With a heart of furious fancies;
> Whereof I am commander,
> With a burning spear,
> And a horse of air,
> To the wilderness I wander
> With a knight of ghosts and shadows,
> I summoned am to Tourney,
> Ten leagues beyond the wide world's end,
> Methinks it is no journey.

In 1737 "A short account of the Town's Hospital in Glasgow with the regulations and abstract of the expenses for the first three years" was published. In this pamphlet it is stated that the directors have it under consideration, especially if the house be encouraged with benefactions to build a more convenient infirmary and also proper apartments for people who have lost the use of their reason—which is a thing very much wanted—there being nothing as yet of that kind in North Britain. And such apartments might be useful not only for people under that calamity, who belong to the place, but also for such people from other places on reasonable terms.

Glasgow was also the first place in Scotland where a hospital

was erected. The site of this hospital was in Clyde Street to the east of St. Andrew's Catholic Chapel. Behind the main building of the hospital there was an Infirmary 167 feet long by 25 feet broad. The ascent to this was by a flight of steps. The lower part of this building was allotted for the reception of lunatics.

The manner in which the lunatics are housed is not recorded, but it is apparent they were kept under a system of restraint and seclusion which did not differ from that obtaining in Paisley where the parts of the madhouse were designated cells, and the inmates restrained by the accompanying illustrated apparatus.

Dr. Fraser of Paisley has on record that in 1792 a man deprived of his reason was refused admission to the Paisley Bedlam, there being no proper apartment in it for lodging him, nor fit person to attend him, the people in the house being old and infirm, and an offer is made to co-operate with the kirk-session who made the application to get the man admitted to the cells or madhouse of Glasgow. The directors of the Glasgow Asylum were kept at their duties by this rule :—

Whoever neglects to visit the house in his turn shall pay a shilling, and sixpence more if he does not attend the next weekly meeting of Committee "the money to go for the use of the poor."

The cost of maintainance of each lunatic was 1s. 3½d. per week or £3 8s. 5d. per annum. The cost of lunatics at the present day in Glasgow Asylums is 10s. 6d. Lest these figures might savour of insufficient dietary of the insane in the 1st Town's Hospital on the one hand, or undue luxury in the treatment of lunatics at the present day, I bring before your notice the rate of prices obtaining in 1733 and 1900, and the weekly dietaries to the patients of the Town's Hospital in 1733, and the inmates of Woodilee Asylum in 1900.

In 1818 as the result of a report entitled "A Report for the Directors of the Town's Hospital of Glasgow on the management of the City Poor, a new hospital was erected on a site known as Spring Gardens to the north of the Royal Infirmary. In the old Town's Hospital at the time this report was issued the lunatics were divided into two classes :—

1. Idiots or Fatuous.
2. Lunatics.

These were further sub-divided into those who did not work and those able to work. The total number of pauper lunatics in 1818 in Glasgow was 96 or 1 to 1291·77 of a population

which compared with 1 to 347·3 at the present day shows the comparative absence of lunacy in Glasgow in the beginning of last century.

Taking both the idiots and lunatics the two classes noticed 34 are in such a state of mind that their services can be made available to a certain extent; and 36 are altogether impotent. Of the 96 patients thus chargeable to Glasgow, 70 were in the Town's Hospital, and 26 in the Lunatic Asylum. The sum paid to the Lunatic Asylum an institution (which will be referred to later in the evening) was at the rate of 8s. weekly, or £21 per annum for each patient. The report goes on to state—"The sum of £21 per head, which, though in one view moderate is by far too much for any pauper, unless great ulterior benefit is to be derived. A distinction therefore appears requisite if there be cases, which present a rational prospect of cure, a fair trial may be made in the Lunatic Asylum, but when this object appears hopeless they should immediately be brought back to the hospital, where they should receive the attention necessary in their melancholy situation but consistently with due economy."*

Perhaps it may not be too much to expect that by pursuing the same mild, yet firm course, adopted in the Lunatic Asylum the same benefit may be derived. Every means of occupation which the varied state of intellect will admit ought to be provided for all these paupers, so as to distract the attention from the prepossessions that prey on their mind. Simple or easy work will be highly useful. A number of the idiots in particular whose case is absolutely hopeless, possess sufficient discrimination for the ordinary out-door employments, and to this object their physical powers are at present directed. In short, the same rule should be applied to all these melancholy subjects as to all the rest of the inmates to make them work to the utmost prudent extent of their capacity.

A separate building will be indispensable, for the reception of these persons, as much detached as possible from the rest of the establishment. It should be formed so as to completely divide the two classes, *i.e.*, idiots and lunatics, and for the health and

* I quote the report further as it is apparent from its reading that the directors of the Town's Hospital were permeated with the enlightened views as to the treatment of the insane that Pinel and Tuke had but a few years previously introduced.

recreation of each a space of ground should be assigned with a wall between. This will be peculiarly desirable for the confirmed cases. As to the liberties of the partially insane and the slightly idiotic, the discretion of the managers must prescribe according to the diversified shades of the mental disease.

The plan of the new building was constructed on a principle similar to the lunatic asylum. Different sides were assigned for the males and females. A certain number of separate cells was considered requisite for the frantic and desperate lunatics, while others whose disorder was either mild or convalescent, and whose conduct was correct and decent, were allowed to intermix with society.

The idiots who were considered all harmless and all hopeless, the report states, for them no solitary accommodation can be of use; but even in this calamity there are degrees various as the constitution of the human intellect. The chief object of attention in such an institution as this will be to discriminate according to the capacity for exertion in each to prevent the exposure of whatever may be offensive, and to attend to the wants and necessities of all.

This foundation-stone of the lunatic asylum in Bell's Park was laid in 1810 and opened in 1811 for the reception of patients. It was erected from the designs of Mr. William Stark whose object was to erect a building where there was a system of arrangement of a very minute and apparently complicated kind united to great ease and simplicity of management, a superintendence unusually active and efficient which follows and watches every motion of the patient while it ensures to him a more than ordinary degree of individual liberty, of exemption from restraint and bondage, of personal security, of ease, comfort, and enjoyment.

The original building contained 136 apartments for the use of patients. Each ward has a gallery 70 feet long by 7 feet 6 inches wide in which the patients take exercise in bad weather.

The whole building is heated by rarified air, generated in the sunk storey and communicated by concealed flues to the various apartments and galleries. The airing ground, which is laid out in gravel walks, shrubberies, and flower-plots, is subdivided by high walls, and the different classes of patients have separate entrances of their own. Patients were admitted to the asylum at rates of board varying from 8s. to £3 3s weekly.

As has been seen, the pauper cases from the city who had a prospect of recovery were accommodated in the asylum.*

The Lunatic Asylum was sold in 1840 to the Directors of the Town's Hospital, and 66 acres of ground purchased for a new asylum. The foundation-stone of this new asylum was laid at Gartnavel in 1842, and in the following year patients were removed to it.

Pauper patients were accommodated in Gartnavel until a few years ago; it is now reserved for private patients.

The withdrawal of pauper patients from Gartnavel Asylum was gradual, and due to the erection by various parishes of lunatic wards attached to their workhouse. Thus all the patients of the Barony Parish of Glasgow were accommodated in Barnhill Poorhouse from 1851 until the opening of the Parish Asylum at Woodilee in 1875. The example of the Barony Parish was followed by other parishes, and now nearly all pauper lunatics in Glasgow are accommodated in the asylums of Woodilee, Gartloch, and Hawkhead.

To illustrate modern methods of treatment of the insane, I bring before your notice two asylums which present very different features—the Glasgow District Asylum at Woodilee, and the German Asylum of Alt Scherbitz, which accommodates chiefly pauper insane from the kingdom of Saxony.

The one asylum is built on the block and corridor principle; the other consists of a number of villas similar in external appearance to suburban residences in Scotland. The block and corridor asylum allows of all the patients in the asylum being accommodated in large dining and recreation halls without consideration of climatic conditions. The village system is less institutional and more home-like in character. To have an intelligent appreciation of these asylums it must further be stated that in our Scottish

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* While the new asylum was thus a great advance on the old, as far as the care and comfort of the patients was concerned, it was still chiefly composed of single rooms which took the place of the cells of the Old Town's Hospital, and curious treatment was still meted out to the patients. In 1817 one of the officers is specially thanked by the Directors for the invention of a leather muff which is better and much less irksome than a strait waistcoat, while it is more seemly than handcuffs of iron and in cold weather less disagreeable. And in 1819 we read that rotatory motion by means of a whirling chair has of late been tried in a great number of cases, and in some of them with wonderfully good effect.

asylum there are only a few buildings outwith the main asylum for the accommodation of the quieter and more inoffensive classes of patients. The great majority of these classes are sent in Scotland to country districts far removed from the district asylum. In Germany all the harmless and inoffensive patients remain in the asylum and are housed in a part of it known as the Colony. *

Woodilee Asylum, one of the two asylums belonging to the Glasgow District Lunacy Board, accommodates 885 patients, 850 lunatics, and 35 idiot children. The asylum was first opened in 1875, and at that time built to contain 400 patients. Subsequent additions have raised the available accommodation for the number of patients already mentioned.

The main building is in the Elizabethan style of architecture, and is slightly over a quarter of a mile long with a corridor running its entire length.

In the administrative block there is situated a large kitchen from which food is supplied to all the patients occupying the main building and home for idiot children; a dining hall where more than 600 patients daily have their meals, and a large recreation hall for the many and varied entertainments to the patients.

From the administrative centre two conservatory corridors lead into a chapel seated for 390 patients.

Attached to the main building are two hospitals, one for males and the other for females. Each of these hospitals has a dining hall and kitchen, so that the hospitals, while attached to the main building, are complete in themselves.

The Asylum was the first to be erected without airing courts, and with day-rooms, in appearance, like ordinary sitting-rooms. The sitting-rooms face to the south, where there are extensive grounds for the recreation of the patients. The patients are not, however, confined to the grounds immediately to the south of the Asylum for exercise; they have at their disposal many walks over the whole of the Asylum lands, nearly 500 acres in extent.

Every lawful day during the year, weather permitting, all able-bodied male patients, and sometimes a few of the female patients,

* Sir William Gairdner, in his book "The Physician as Naturalist," speaking of the modern system of treatment of the insane, says:—"Taking origin in the last decade of the 18th Century this may be said to culminate in the present decade of the 19th in such a large pauper asylum as Woodilee which, at half an hour's distance from Glasgow and easily accessible at all hours by rail, may be specially commended to your notice."

find employment in the various workshops of the Asylum, in the gardens, and farms. The Home Farm, at which 37 patients are housed, is most fully equipped, and from it the Asylum draws its supplies of milk, meat, meal, etc. About a mile from the main building is a second farm—Muckcroft—where there is accommodation for 14 patients who all find suitable employment in the garden and other grounds of the farm.

At a third farm—Wallflat—eight female patients are in residence who take care of the poultry and fowls at this place. A number of male patients—eight—are housed at the lodge at the main entrance of the asylum. The latest addition to the asylum is a building for 35 idiot children.

All patients who can be employed are actively engaged—the women chiefly at needle, laundry, and kitchen work; while the 500 acres of ground which surround the Asylum afford occupation in farm and garden work for the men.

A great variety of work has recently been introduced to the Asylum by the establishment of a Brabazon Society. This consists of a committee of ladies who meet a number of patients weekly, and teach them rug and basket-making, painting, wood-carving, embroidery, etc. Not only are the patients benefitted, in that their minds are distracted by the varied occupations introduced into their midst and the pleasure of associating with the world outwith the Asylum, but the society does infinite good in breaking down the last remnant of that barrier which regards the insane as outside the pale of society.

The Alt Scherbitz Asylum is one of two asylums for patients from the kingdom of Saxony. It was completed in 1885, and had accommodation for 800 patients of that time. The addition of a building known as the Emperor William Augusta Foundation in commemoration of the late Emperor William's golden wedding has raised the accommodation of Alt Scherbitz to 960 beds. The Asylum contains pauper patients chiefly, but there are a number of private patients.

It is about half a mile from Skeuditz, a wayside station on the main line from Halle to Leipsic. Unless one is prepared beforehand as to the nature of the place, he might pass along the main road from Halle to Leipsic with the impression that the numerous villas to be seen on each side of the road were those of suburban villa residences.

This public road from Halle to Leipsic passes from north-west

to south-west through the middle of the Asylum. On the north side of the road are the villas for male and female patients who require constant observation and daily medical supervision. These villas are grouped round an administrative building, and accommodate 550 patients. The only building having an institutional appearance is situated in this part of the Asylum. It is the Kaiser Wilhelm Augusta Foundation, already noticed, where 160 senile and infirm patients of both sexes are housed.

In the villas of this medical or central portion of the Asylum, the various patients are classified as

1. Those requiring special attention and observation; for instance, all newly admitted cases.
2. Those requiring constant observation and attention on account of suicidal or homicidal tendencies or unusual restlessness, and patients attempting to escape.
3. Patients who are under probation until their conduct shows whether they are able to be discharged from the asylum or sufficiently trustworthy to be sent to the Colony—the other portion of the Asylum still to be observed.

Finally there is a small hospital for 32 patients of both sexes, where patients suffering from serious bodily disease are treated.

In the Colony to the south of the Halle to Leipsic Road are 410 patients. The male patients reside in villas which are grouped round the workshops and the farm steading. The female patients in the Colony are housed in villas grouped round the kitchen and laundry. In the Colony in addition to these villas are, the old mansion house of Alt Scherbitz now the medical superintendent's residence, the recreation hall for the asylum patients with a billiard room and skittle alley attached to it, and the hamlet of Alt Scherbitz from which the Asylum takes its name.

A number of the houses (the village inn included) in this hamlet are the property of the Asylum, and serve for the accommodation of the class of patients that are boarded out in Scotland. Ultimately all the houses in Alt Scherbitz will be taken over by the Asylum authorities. The water supply and electricity for lighting the various houses are distributed from buildings placed in the centre of the Colony.

From the kitchen food is distributed to all the houses by means of a special van drawn by a couple of horses. This van is

divided into compartments lined with non-conducting material into which zinc cases, one for each villa or house, are placed to contain the necessary food. Two journeys of the van each occupying about a quarter of an hour are sufficient to supply the whole Asylum. I had an opportunity of tasting the food at one of the outlying houses as soon as it was delivered, and can testify that it had lost little or no heat in its transit.

The villas, accommodating 25 to 50 patients, are all different in external appearance, of a simple yet pleasing architecture. In the medical portion of the Asylum each villa has a garden surrounding it, enclosed by simple wooden palings.

In what is known as the closed villas, where the liberty of the patients is restricted—it is intended that these wooden palings remain—in all the other villas the wooden palings are gradually being replaced by hedges.

The internal arrangement of the houses is very simple. The ground floors are on a level with open verandahs—so that bed-ridden patients may be wheeled out to enjoy the fresh air and sunshine. What is known as the open door system, first introduced in Scotland at Woodilee Asylum, prevails largely in Alt Scherbitz.

This system allows a great amount of freedom to the majority of the patients in that they are able to move freely from one room to another without the use of keys, and in a number of instances parole is extended to the patients as it is in Scotland, so that they are free to walk all over the asylum grounds, and as far as the village of Skenditz.

As with all other Asylums, adopting the free and enlightened policy of modern treatment of the insane, Alt Scherbitz has fewer accidents and escapes than other German Asylums. While the cost of such institutions as Alt Scherbitz cannot be compared with Asylums in our countries, compared with other German asylums and especially those built on the block and corridor system, Sir John Sibbald states that the cost is much lower.

Statistical Information.

During the year 1898-1899, the average number of patients in Scotland in asylums, lunatic wards of poorhouses, and private dwellings, was 12,839. For the maintenance of each of these patients a sum of £24 was spent; £10 12s. of this amount by Government and the relatives of the patients, £13 8s. by the Parish authorities.

The average number of pauper lunatics has increased from 6,912 in 1876, to 12,799 in 1899. That is to say, in twenty-three years it has almost doubled itself.

The average discharge and death rates for the same period is eighty-seven per cent. of the admissions. An analysis of the number of lunatics chargeable to each county in Scotland shows :—

1. A marked prevalence or the reverse in certain counties as compared with others.
2. A marked increase in the number of the insane generally, not accounted for by increase of population only.

In the first place, it may be noted that the four counties showing the greatest prevalence of insanity are :—

Argyll, - - -	1 to 168	of population.
Inverness, - -	1 to 183	,,
Sutherland, - -	1 to 199	,,
Banff, - - -	1 to 202	,,

And the four counties freest from insanity—

Selkirk, -- -	1 to 447	,,
Dumbarton, - -	1 to 435	,,
Clackmannan, -	1 to 419	,,
Linlithgow, - -	1 to 408	,,

In seeking for an explanation of these facts, it may be stated in the first place, almost as an axiom, that increase of insanity is in direct ratio with increased civilisation.

The barbarian escapes the scourge because he is exempt from many of the physical, and almost all the moral sources of mental excitement. The members of a civilised community are subject to insanity because the enjoyments and blessings of augmented power are abused, because the mind is roused to exercise without any discipline, it is stimulated without being strengthened, because our selfish propensities are cultivated, while our moral nature is left barren, our pleasures becoming poisonous, and because in the midst of a blaze of scientific light, and in the presence of a constant temptation to multiply our immediate by a sacrifice of our ultimate qualifications, we remain in the darkest ignorance of our own mind, its true relations, its dangers, and its destiny. With civilisation there come sudden and agitating changes and vicissitudes of fortune, vicious effeminacy of manners, complicated tran-

sactions, misdirected views of the objects of life, ambitions, and hopes, and fears, which man in his primitive state does not and cannot know. But these neither constitute, nor are they necessarily connected with civilisation. They are defects, obstacles which retard that improvement of condition towards which every discovery in art or ethics must ultimately tend.

The prevalence of insanity then is great in all large cities which have these defects of civilisation and causes of the disease in the greatest mass. Still the prevalence of insanity is greater in such country districts as the Highlands of Scotland than it is in our large cities, Glasgow, for instance. The explanation of this great prevalence lies in two reasons.

In the first place, a great draft takes place on country resources through the needs and prospects held out in cities, and the country is thus robbed of its youngest, best, most active and healthiest of its population. In the second place, intermarriage prevails to a great extent in Highland communities, and this narrows the sphere of action of any disease, either inherited or acquired.

The second question, Is insanity increasing? is best answered by an enquiry into the statistics of a large urban community, for there, if I have conveyed my meaning aright, the production of insanity apart from the two features causing insanity in rural districts, should be greatest. Glasgow consists of two large parishes, chiefly Glasgow and Govan. The population of these two parishes is 881,000, and the number of insane chargeable to both parishes (exclusive of imbecile children), is 2,536. This gives us 1 to 347·3 persons.

These figures compare most favourably with the general average for the 33 counties in Scotland.

This average gives one lunatic to every 261·7 of the population.

The question, Is insanity increasing? must be considered in the light of the number of new cases of insanity arising each year in the community. In an annual report on the certification of lunatics for the year ending 15th May, 1900, the certifying physician, as a result of the analyses of the statistics for the last ten years of the Barony Parish of Glasgow arrives at the conclusion—That the figures do not reveal any increased production of pauper lunacy during the period under investigation.

In 1890 a system was inaugurated at Barnhill Poorhouse, which allowed of wards to be set apart for the observation of doubtful cases of lunacy. This system continues to the present day in the

Glasgow Parish. It may be urged against the conclusion that there is no increased production of insanity in the Barony Parish, that certain cases which, in ordinary circumstances, would have been admitted to the asylum, were sent to the observation wards only.

Sir Arthur Mitchell, in investigating the alleged increase of lunacy in Scotland, selected for this purpose the lunacy statistics of the Barony Parish of Glasgow, for the years 1882-1892, ten years, during which there were no observation wards at Barnhill. Sir Arthur Mitchell's conclusion was there was no increase in the occurrence of pauper lunacy, but actually a slight decrease.

The average yearly production for the first five years of the decade under consideration being 41 per 100,000 of a population, and for the second five years, 40·1 per 100,000. On the evidence of the two authorities thus quoted, there has been no increased production of lunacy in the large urban district under review. The increased number of lunatics is due to an admission rate in excess of a combined discharge and death rate, in other words, to an accumulation of unrecovered cases.

An analysis of the causes of insanity reveals the fact that there are three of primary importance, heredity, alcoholism, and immorality. These three causes account for at least sixty per cent. of all cases admitted to the asylum.

In estimating the causes of insanity, I have included, under the heading of immorality, seventy-five per cent. of all the cases of general paralysis of the insane. This disease has of late received much attention, and as the result of careful and accurate research, is shown to be due at least in seventy-five per cent. of the cases, if not in all cases, to syphilis.

General paralysis of the insane is always fatal in three or four years from its onset. It occurs at all ages, but chiefly effect men and women in good health, with a good family history, in the prime of life.

An authentic history of patients admitted to the asylum is sometimes difficult to obtain. I have gone carefully into the causes of insanity in all the patients admitted during the last five years to Woodilee Asylum, in whose cases a history has been furnished by their friends, and this analysis shows an inherited tendency to insanity in 23½ per cent., intemperance in drink 20 per cent., and a mixed causation of heredity and intemperance, both as regards drink and morals, in 16½ per

cent. The scope of this paper allows me to touch only on one of the three causes mentioned, alcoholism.

It is not the function of alcohol I wish to discuss, nor the disastrous effects that intemperance produces on our body, but alcoholism as a factor in the production of insanity, and suggestions for the remedy of defects in the mode of dealing with inebriates or habitual drunkards.

I would preface my remarks by stating a constant truth that is forced on one, is that while the victims of alcoholism are a source of misery and degradation to others, they are often the source of the production of insanity in others.

Men and women worried by the spendthrift habits of the alcoholic, and constant association with misery, despair, and starvation, unable to bear these additional burdens in the wear and tear of daily life lose their mental balance. The idiot, the epileptic, the mentally weak and unstable, are all legacies to his country of the victim of alcoholism.

A Continental authority assures that in habitual drunkenness there is an ancestral history in 60 to 70 per cent. of the cases of insanity. In such cases there is a morbid and direct impulse for alcohol or a predisposition to the excessive and inordinate use of alcohol. With the habitual drunkard must be classed those who have a strong predisposition for drugs which would relieve any kind of pain, opium, chloral and kindred drugs. These have an equally disastrous effect on the mind as alcohol, and the victims differ only from the habitual drunkard in the different object which ministers to their craving.

Until recently the lawyer, the judge, had only one remedy for the habitual drunkard, the prison. The prison has not in the past remedied the state of the inebriate, it has failed utterly in its object. The Inebriates' Act of 1898, through which special homes have been established, affects only a very few of the inebriates, so long as they are not convicted of drunkenness four times in one year they are not habitual inebriates in the eye of the law, and the habits of the majority of inebriates make them safe from coming within the scope of the Inebriates' Act. A drunkard cannot be put into a lunatic asylum, he is not insane in the eyes of the law, if in an unusual bout of drinking he acquires delirium tremens, and is placed in an asylum, free from drink he recovers so soon that his confinement is only a matter of a few weeks, too short a time to eradicate a habit which implies a mental flaying

alive to get rid or beyond the sheltering walls of an institution of some kind.

In Switzerland, Germany, Austria, and other countries a system preferable to ours prevails. A new German law exacts the compulsory treatment of habitual drunkards, whose exact description is :—

He who in consequence of inebriety cannot provide for his affairs, or brings himself or his family into danger of need, or endangers the safety of others. The system of Curatel has been adopted in Austria. This also entails compulsory treatment of inebriates and is not a harsh measure. The law of Curatel provides for the foundation of a retreat for the treatment of drunkards apart from asylums for the insane, to which the drunkard is sent either on his own application or the demands of the magistrates or judges, and is detained there from nine to eighteen months. Before the discharge of the patients they are still under surveillance. A specially constituted court provides for the appointment of a curator or administrator of the properties of persons declared incapable through drunkenness of managing their own affairs.

It takes cognisance of all persons, rich or poor, with respect to whom application for curatel is made by relatives, or parish, or asylum authorities. I understand these retreats in Austria are chargeable to the State. A scheme which would make institutions of the kind self-supporting, at least not a burden on the rates, would, I am sure, receive much support in this country.

[Numerous illustrations were given at this stage of the lecture, by letters of patients, etc., of the life at an asylum].

Before bringing this paper to a conclusion, I must speak shortly of the change that has come over those in immediate charge of the insane. In Hogarth's pictures of Bedlam the keepers are depicted with whips stuck in their girdles, and it is on record that when the calamity of insanity fell on George the Third that, on one occasion, the keeper knocked him down flat as a flounder.

In our modern asylums the term keeper has given way to that of nurse or attendant, and by means similar to those employed in the training of nurses in general hospitals the status of asylum nurses has been greatly raised. In the hope of promotion, these nurses now obtain a certificate, granted by a body independent of the particular asylum in which the nurses and attendants are, viz., the Medico-Psychological Association. This certificate is only

given to those whose character and conduct have been correct, and who have been in the asylum and attended a definite course of lectures and clinical demonstrations during their service in the asylum.

It is hoped that the day is not far distant when the insane will be cared for by a body of men and women who will differ from the nurses engaged in general hospitals only in that they have added to a general nursing training a special aptitude for nursing the insane.

Time does not permit me to speak of the advance of medicine in relation to insanity; of discoveries by physicians through the microscope and otherwise of many of the causes of insanity, and the effects of these causes on the nerve cells—the seat of mind. Much has been done—much remains to be done—ere the famous question of Macbeth's be answered—

> Canst thou not minister to a mind diseased,
> Pluck from the memory a rooted sorrow,
> Raze out the written troubles of the brain?

Rules Governing the Competition for the Graham Medal.

(Printed by Order of the Council).

1. The competition for the Graham Medal shall be under the authority aud control of the Council of the Philosophical Society of Glasgow, whose decision on all points connected therewith shall be final.

2. Each candidate shall forward to the Secretary of the Philosophical Society of Glasgow, 207 Bath Street, Glasgow, on or before 14th March of the year in which the competition is held, a paper giving an account of an unpublished original research conducted by himself in any branch of chemical science.

3. The medal shall be awarded to the candidate whose research, in the opinion of the Council, or of the person or persons whom they may appoint to adjudicate in the matter, is of the highest merit, and most likely to aid in the advancement of chemical science.

4. The successful candidate shall read the paper, on account of which the medal is awarded, to the Philosophical Society of Glasgow. The paper shall thereafter be published in the *Proceedings* of the Society, and its publication elsewhere shall not take place without the permission of the Council.

5. No award shall be made if, in the opinion of the Council, no candidate has contributed a paper of sufficient merit.

MINUTES OF SESSION.

1900-1901.

7th November, 1900.

The First Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 7th November, 1900, at eight o'clock—The President, the Right Hon. Lord Blythswood, occupied the Chair.

1. The Hon. Secretary intimated that no Minute would be read, as that for the previous Meeting was published in the last issue of the *Proceedings*, and had been read and approved at the close of the Meeting itself.

2. The President in suitable terms introduced Mr. William S. Bruce, F.R.S.G.S., who delivered a lecture entitled "Arctic and Antarctic." The lecture, which was a contribution from the Geographical and Ethnological Section, was copiously illustrated by slides from photographs taken mainly in the Antarctic Region. At the close, a hearty vote of thanks was passed to the Lecturer on the motion of Lord Blythswood.

3. Mr. Wm. Jas. Wood and Mr. Alexander Fyfe were appointed to audit the Hon. Treasurer's books.

4. The Hon. Secretary announced that the following gentlemen had been elected Members of the Society:—

1. JAMES H. PARKER, B.L., C.A., 89 West Regent Street. Recommended by Mr. John Dansken, Mr. Alex. Sommerville, and Mr. A. B. Dansken.
2. W. R. BAXTER, 64 Gt. George Street, Hillhead. Recommended by Mr. A. C. Whyte, Dr. Fergus, and Mr. John Robertson.

3. J. SOUTTAR M'KENDRICK, M.D., F.R.S.E., 2 Buckingham Terrace. Recommended by Dr. Fergus, Mr. John Robertson, and Dr. Walter K. Hunter.

4. JOHN WATSON, National Bank, Crosshill. Recommended by Dr. Wm. Watson, Mr. John Robertson, and Dr. Fergus.

5. R. C. CRAWFORD, Painter, 12 Derby Crescent, N. Kelvinside. Recommended by Mr. A. C. Whyte, Dr. Fergus, and Dr. J. B. Mackenzie Anderson.

6. JAMES W. WALLACE, M.D., C.M., 67 St. Andrew's Drive, Pollokshields. Recommended by Dr. Fergus, Dr. Walter, K. Hunter, and Principal M'Lean.

7. JOHN ROWAN, M.B., F.F.P.S.G., 9 Blythswood Square. Recommended by Dr. Fergus, Dr. Walter K. Hunter, and Dr. J. B. Mackenzie Anderson.

8. F. W. HARRIS, Corporation Chemist, 81 Gower Street, Kelvinside, N. Recommended by Prof. E. J. Mills, Mr. John Mann, and Prof. Blyth.

9. PETER BENNETT, Lecturer in Mathematics, Glasgow Technical College, and Professor of Physics, Anderson's College Medical School, 2 Franklin Terrace, Sandyford. Recommended by Dr. Henry Dyer, Mr. Robert Goodwin, and Dr. Fergus.

10. WALTER COLQUHOUN, M.A., M.B., C.M., 7 Stanley Street, W. Recommended by Prof. Watkinson, Mr. H. F. Stockdale, and Prof. Magnus Maclean.

11. CHARLES GOURLAY, B.Sc., A.R.I.B.A., Professor of Architecture, Glasgow Technical College, 204 George Street. Recommended by Dr. Fergus, Principal M'Lean, and Mr. John Mann.

REPORT OF COUNCIL FOR SESSION 1899-1900.

I. The Council are pleased to be able to report that the past session was one of steady progress. The number of Papers read at the meetings of the Society did not reach the abnormally large number of the preceding session, but the communications were not surpassed in quality by those of any previous session, and evoked many interesting discussions. It is also gratifying to note that an unusually large number of members took an active part in the work of the Society during the session.

II. The session was brought to a close with a highly successful lecture by the eminent scientist, Sir W. Roberts-Austen, on "Molecular Unrest in Solids." The lecture was delivered under the auspices of the Graham Medal and Lecture Trust.

The Competition for the Graham Medal was, as in the previous session, advertised in the leading scientific journals, and especially those devoted to the science of chemistry. But, although several applications for the conditions of the competition were made, no paper was sent in.

III. *Sections.*—The Architectural Section met regularly throughout the Session, and one of the communications read at its meetings was printed in Vol. XXXI. of the *Proceedings*. Valuable contributions for the meetings of the Society were received through the Economic Science, Philological, Sanitary and Social Economy, Mathematical and Physical, and Geographical and Ethnological, Sections.

IV. *Proceedings.*—Early in the Session the Council resolved to obtain a contract for the whole printing work of the Society. Articles were accordingly issued, and estimates received from the best known printing firms in the city, but not till the end of February was an agreement finally made. Until the Completion of the contract the printing of the *Proceedings* could not be commenced. This initial delay of three months was compensated for as much as possible by hurrying on the work during the summer, with the result that Vol. XXXI. was issued to Members in October, or only one month later than last year.

V. *Membership.*—At the beginning of the Session there were 623 Ordinary Members on the roll. During the Session 40 Members were elected, one of whom, however, did not pay entry-money—and 2 reinstated from the Suspense List, making a total of 665. Of these 12 have resigned, 20 have died, 4 have been placed on the Suspense List, and 3 have been struck off the roll for non-payment of subscription, so that at the beginning of Session 1900-1901 there were 626 Ordinary Members on the Society's list. Amongst those who have died we notice the names of Mr. Alexander Osborne, Mr. James Deas, C.E., Sir Renny Watson, Dr. J. E. Brodie, Mr. E. C. C. Stanford, Dr. George A. Turner, and David Ross, LL.D. Of the new Members admitted during the Session, 3 qualified themselves as Life Members. There are now 162 Members of that class out of 193 who have so enrolled themselves. The roll now includes 16 Honorary Members, 8 Corresponding Members, and 626 Ordinary Members (Annual and Life), or a total of 650.

VI. *Library.*—Annexed is the Report by the Hon. Librarian, from which it appears that large and valuable additions have been made to the Library during the past year.

VII.—*Finance.*—The Treasurer's statement for 1899-1900 opens with a balance of £87 11s. 2d. due to him, against which there was an investment in railway stock of £47 9s., the remainder at cost, of a larger investment partly sold. The accounts close with £14 13s. 7d. due to the Treasurer, with the same investment standing against it. It is believed that, as usual at the close of the financial year, the Society has practically no other outstanding liability.

Separate statements are given by the Treasurer, as formerly, showing the position of the two funds which the Society holds in trust, viz. :—"The Graham Medal and Lecture Fund" and "The Glasgow Science Lecture Fund," the balances of revenue being £39 10s. 9d. and £19 5s. 7d. respectively.

By Order and in Name of the Council,

(Signed), FREELAND FERGUS,
Honorary Secretary.
PETER BENNETT,
Acting Secretary.

REPORT OF THE LIBRARY COMMITTEE.

Your Committee have to report that during the past Session, the number of members who took books from the Library were scarcely so large as in the previous year. 640 books, and 434 periodicals were issued to Members.

There were added to the Library, by purchase, 54 volumes, and 6 parts of works, and 35 volumes, 32 parts, and 20 pamphlets were presented.

Of the 94 periodicals at present received, 35 were presented, and 59 are bought. These are representative of science in all parts of the world.

Copies of the last year's *Proceedings* of the Society were sent to 180 Societies and Public Departments, and 152 volumes and 150 parts of works were received in exchange. Many extremely interesting and valuable papers are contained in these publications.

Altogether, during the year, the Library has been increased by 239 volumes, 188 parts, and 20 pamphlets, thus bringing the estimated number of volumes up to 13,768.

Since last report, 197 volumes have been bound.

In Vol. XXXI. of the *Proceedings*, there will be found a list of the additions to the Library, by purchase, up till June, 1900, the titles of the books presented, with the names of the donors, the names of the societies, etc., with which exchanges are effected, and a list of the periodicals received at the Library.

It is the aim of the Committee to have the new catalogue ready, if possible, for the Centenary of the Society in 1902.

JOHN ROBERTSON, HON. LIBRARIAN,
Convener.

21st *November*, 1900.

The Annual Business Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 21st November, 1900, at eight o'clock—Mr. John F. Campbell, Vice-President, in the Chair.

1. The Minute of previous Meeting, of date 7th November, 1900, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

Dr. ABSTRACT OF HONORARY TREASURER'S

AND COMPARISON WITH

			1899-1900.	*1898-99.*
			£ s. d.	£ s. d.
To BALANCE from last year—				
Investment, Caledonian Railway £110, 3 per cent. Preferred, Converted, - - - - - -			47 9 0	*47 9 0*
,, SUBSCRIPTIONS to 31st October, 1900—				
40 Entry-moneys of 1899-1900, at 21s., -		£42 0 0		
Annual Dues at 21s.—				
Arrears, - - - -	£2 2 0			
For 1899-1900, 441 Ordinary Members, - - -	463 1 0			
Do., 37 New Members, -	38 17 0			
		504 0 0		
Life Subscriptions at £10 10s.—				
4 Old Members, - -	£42 0 0			
3 New Members, - -	31 10 0			
		73 10 0		
			619 10 0	*624 15 0*
,, DIVIDENDS ON INVESTMENT—				
Caledonian Railway, April, 1900, less Tax,		£1 11 11		
,, ,, Oct., ,, ,,		1 11 6		
			3 3 5	*3 3 10*
,, GENERAL RECEIPTS—				
Bank Interest, - - - - -		£2 12 9		
Proceedings, &c., sold, - - - -		7 10 7		
			10 3 4	*3 6 11*
,, ARCHITECTURAL SECTION—				
90 Associates' fees at 5s., - - - - -			22 10 0	*21 10 0*
,, ECONOMIC SCIENCE SECTION—				
11 Associates' fees at 5s., - - - - -			2 15 0	*3 5 0*
,, GEOGRAPHICAL AND ETHNOLOGICAL SECTION—				
14 Associates' fees, for 1898-99 and 1899-1900, at 5s.,			3 10 0	*0 0 0*
,, PHILOLOGICAL SECTION—				
3 Associates' fees at 5s., - - -		£0 15 0		
Subscriptions for purchase of Phonograph,		*13 0 0*		
			0 0 0	*13 15 0*
,, BALANCE due to Treasurer, - - - - -			14 13 7	*87 11 2*
			723 14 4	*804 15 11*

Memo.—The Society's Investments are—

(1) Bath Street Joint Buildings, as in last Account, - -	£3,933	7 4½
Less Society's half of Bond, - - - - -	1,200	0 0
	£2,733	7 4½
(2) Caledonian Railway Stock, as above (present value, £95 3s.),	47	9 0
	£2,780	16 4½

ACCOUNT—SESSION 1899-1900, *Cr.*

SESSION 1898-99.

		1899-1900.	*1898-99.*
		£ s. d.	*£ s. d.*
By BALANCE from last year—due to Treasurer,		87 11 2	*54 11 11*
,, GENERAL EXPENDITURE to 31st October, 1900—			
Ex-Secretary's retiring allowance (2nd year),	£40 0 0		
Remuneration to Acting Secretary,	50 0 0		
Allowance for Treasurer's Clerks,	15 0 0		
Commission to Collector,	5 10 3		
		110 10 3	*111 15 6*
New Books and Periodicals, British and Foreign,	£120 0 6		
Bookbinding,	33 0 8		
Printing Circulars, *Proceedings*, &c.,	120 19 5		
Postage and delivery of circulars, letters, etc.,	37 6 6½		
Stationery, etc.,	8 0 10½		
		319 8 0	*413 7 8*
Fire Insurance on Library for £5,400,	£6 10 0		
Postages, etc.—Per Secretaries, £3 7s. 1d.; per Treasurer, £2 14s. 10½d.,	6 1 11½		
		12 11 11⅓	*11 16 6*
,, Joint Expenses of Rooms—Society's half of £278 5s. 9½d., being Insurance, Taxes, Cleaning, Repairs, Lighting, and Heating; Salaries of Curator and Assistant, and its proportion of Interest on Bond, £34 16s.; less half of £86 10s., Revenue from Letting,		130 13 10½	*137 15 8*
,, SUBSCRIPTIONS TO SOCIETIES—			
Ray Society, 1899,	£1 1 0		
Palæontographical Society, 1899,	1 1 0		
		2 2 0	*2 2 0*
,, ARCHITECTURAL SECTION— Expenses per Treasurer of Section,		11 19 1	*12 8 6*
,, ECONOMIC SCIENCE SECTION— Expenses per Secretary of Section,		0 11 0	*5 1 11*
,, GEOGRAPHICAL AND ETHNOLOGICAL SECTION— Expenses per Treasurer of Section,		0 12 6	*0 0 0*
,, MATHEMATICAL AND PHYSICAL SECTION— Expenses per Secretary of Section,		0 4 0	*0 0 0*
,, PHILOLOGICAL SECTION— Expenses per Treasurer of Section—		0 1 6	*8 7 3*
,, BALANCE OF— Investment—Caledonian Railway £110 3 per cent. Preferred, Converted,		47 9 0	*47 9 0*
		723 14 4	*804 15 11*

GLASGOW, 16th November, 1900.—We, the Auditors appointed by the Society to examine the Treasurer's Accounts for the year 1899-1900, have examined the same, of which the above is an Abstract, and have found them correct, the Balance due to Treasurer being Fourteen Pounds Thirteen Shillings and Sevenpence Sterling.

(Signed) WM. JAS. WOOD.

JNO. MANN, C.A., *Honorary Treasurer.* ALEX. FYFE.

GRAHAM MEDAL AND LECTURE FUND.

Dr. ABSTRACT OF TREASURER'S ACCOUNT, SESSION 1899-1900. *Cr.*

CAPITAL AT 1ST NOVEMBER, 1899—						CAPITAL AT 31ST OCTOBER, 1900—			
Glasgow and South-Western Railway Co. 4 Per Cent. Preference Stock in name of the Philosophical Society, in Trust,	£250	0	0			Investment, *per contra*,	£250	0	0
Value of Die at H.M. Mint,	18	18	0			Die,	18	18	0
				£268	18 0				£268 18 0
Cash in Bank,	74	19	3			EXPENDITURE—			
Less, due to Treasurer,	2	6	6			Advertising in Technical Journals, Competition for Medal,	£1	6	3
				72	12 9	Honorarium and Expenses for Lecture on 18th April, 1900, by Sir W. C. Roberts-Austen, K.C.B., D.C.L., F.R.S., Master of the Mint, on "Molecular Unrest in Solids,"	42	12	7
REVENUE—									43 18 10
Dividend, March, 1900, less Tax,	£4	16	8			BALANCE, BEING REVENUE—			
,, Sept., ,, ,,	4	15	7			In Bank, on Deposit Receipt,			39 10 4
Interest from Bank,	1	4	2						
				10	16 5				
				£352	7 2				£352 7 2

GLASGOW, 16th November, 1900.—Examined and found correct.

(Signed) WM. JAS. WOOD.

THE SCIENCE LECTURES ASSOCIATION FUND.

Dr. ABSTRACT OF TREASURER'S ACCOUNT—SESSION 1899-1900. *Cr.*

CAPITAL AT 1ST NOVEMBER, 1899—							
£200 Caledonian Railway Company 4 Per Cent. Preference Stock, No. 1, in name of the Philosophical Society, in Trust, cost,				£244	4	8	
On Deposit Receipt,				8	5	4	
						£252	10 0
Cash in Bank (Revenue),						11	2 1
REVENUE—							
Dividend, April, 1900, less Tax,				£3	17	4	
,, Oct., ,, ,,				3	16	6	
Interest from Bank,				0	9	8	
						8	3 6
						£271	15 7

CAPITAL AT 31ST OCTOBER, 1900—							
Investment, *per contra*,				£244	4	8	
In Bank, on Deposit Receipt,				8	5	4	
						£252	10 0
BALANCE, BEING REVENUE—							
In Bank, on Deposit Receipt,						19	5 7
						£271	15 7

Minutes of Session.

GLASGOW, 16th November, 1900.—Examined and found correct.

(Signed) WM. JAS. WOOD.
ALEX. FYFE.

JNO. MANN, C.A., *Honorary Treasurer.*

2. The New Members elected at the previous Meeting were duly admitted.

3. The Annual Report of the Council was presented by the Honorary Secretary, Dr. Freeland Fergus, and was adopted on his motion.

4. The Honorary Treasurer, Mr. MANN, presented the Annual Financial Statement, signed by Mr. Wm. Jas. Wood and Mr. Alex. Fyfe, Auditors, which, on the motion of the Chairman, was adopted.

5. The Honorary Librarian, Mr. Robertson, in presenting the Library Committee's Annual Report, made reference to the New Catalogue in course of preparation, and to the special value of some recent additions to the Library. The Report was adopted, and a vote of thanks accorded to donors of books, etc.

6. Mr. Wm. Ewing proposed Professor Glaister as Vice-President in room of Professor Barr, whose term of office had expired. The motion was unanimously agreed to.

7. On the motion of Professor Glaister—Mr. John Robertson, Mr. John Mann, C.A., and Dr. Freeland Fergus, were unanimously re-elected Honorary Librarian, Honorary Treasurer, and Honorary Secretary, respectively, and a vote of thanks for their past services was accorded to them.

8. On the motion of Dr. James Colville—Dr. John Macintyre, Professor A. Gray, Mr. H. F. Stockdale, and Mr. Wm. Curphey, were elected Members of Council.

9. On the motion of Mr. GILBERT THOMSON, Professor Barr was elected to the Membership of Council, in room of Professor Glaister.

10. Office-bearers for the different sections (see pp. 266-268) were proposed respectively as below, and unanimously elected :—

(*a*) For the Geographical and Ethnological Section—Dr. Fullerton proposed those on list, p. 268.

(*b*) For the Sanitary and Social Economy Section—Mr. Wm. Buchanan proposed those on list, p. 267.

(*c*) For the Mathematical and Physical Section—Dr. Fergus, on behalf of Mr. R. F. Muirhead, proposed those on list, p. 268.

(*d*) For the Economic Science Section—Mr. Robert Lamond proposed those on list, p. 268.

(*e*) For the Philological Section—Mr. John Clark proposed those on list, p. 268.

11. A vote of thanks was accorded to the auditors, Mr. Wm. Jas. Wood and Mr. Alex. Fyfe, on the motion of the treasurer, Mr. John Mann.

12. The business of the Ordinary Meeting was then proceeded with.

Mr. James Colville, M.A., D.Sc., President of the Philological Section, read a paper entitled, "A Boer Admirer of Burns," being a contribution from the Philological Section.

A discussion followed, in which part was taken by Dr. Napier, Prof. Glaister, Mr. Clark, and Dr. Colville.

The Lecturer was accorded a hearty vote of thanks on the motion of the Chairman.

13. The Chairman announced that the following gentlemen had been duly elected Members of the Society :—

1. ALEX. RUNCIMAN, Clerk, 45 Renfield Street.
2. JOHN YOUNG, Merchant, 42 Bath Street.
3. JOHN W. PETRIE, 83 Oxford Drive.
4. WM. FRASER, F.S.I., Surveyor and Valuator, 209 St. Vincent Street.
5. THOMAS SMELLIE FRASER, F.S.I., Surveyor and Valuator, 209 St. Vincent Street.

5th December, 1900.

The Third Ordinary Meeting, for Session, 1900-1901, of the the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 5th December, 1900, at eight o'clock—Professor John Glaister, Vice-President, in the Chair.

1. The Minute of previous Meeting, of date 21st November, 1900, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. The Chairman introduced Dr. Alexander Edington, F.R.S.E., Director of the Colonial Bacteriological Institute, Cape Colony, who read a paper entitled, "Recent Investigations into South African Diseases."

The Paper was a contribution from the Sanitary and Social Economy Section.

A discussion on the subject treated followed, in which Dr. R. M. Buchanan, Dr. Workman, the Chairman, and Dr. Edington took part.

A hearty vote of thanks was accorded to Dr. Edington, on the motion of the Chairman.

4. The Chairman then intimated that, on account of the lateness of the hour, Professor Galt was willing that his paper, which was on the agenda, should be held over till next Meeting, provided leave was obtained.

Leave was granted.

5. The Hon. Secretary announced that the following gentlemen had been duly elected Members of the Society:—

Honorary Member.

SIR WILLIAM T. GAIRDNER, K.C.B., M.D., LL.D., F.R.S.

Ordinary Members.

1. JOHN ALEXANDER, M.D., Physician, 3 Queen's Crescent, W.
2. HENRY ALLAN, 2 Park Gardens.
3. JAMES W. ALLAN, M.B., Physician, 18 India Street.
4. JAMES ANDERSON, 4 Kingsborough Gardens.
5. ROBERT ANDERSON, Manufacturer, Eastwoodhill, Giffnock.
6. WM. ANDERSON, Manufacturer, 12 Princes Square.
7. GRANT ANDREW, Surgeon, 12 Woodside Terrace.
8. JAMES ANDREW, Writer, 160 West George Street.
9. J. ARTHUR, Merchant, 78 Queen Street.
10. MATTHEW ARTHUR, 78 Queen Street.
11. SIR WILLIAM ARROLL, LL.D., Seafield, Ayr.

12. WM. BARBOUR, M.B., C.M., Medical Practitioner, 5 Ashgrove Terrace, Partickhill.
13. WILLIAM BECKETT, M.A., Writer, 225 West George Street.
14. GEORGE BELL, Architect, 212 St. Vincent Street.
15. JOHN BIRKMYRE, Manufacturer, Broadstone, Port Glasgow.
16. WM. R. BROADFOOT, Brassfounder, Inchholme Works, Whiteinch.
17. A. M. BROWN, Merchant, 22 W. Nile Street,
18. GEORGE ARBUCKLE BROWN, M.B., C.M., D.P.H.(Camb.), 2 Oswald Place, Whiteinch.
19. JOHN BROWNLEE, M.D., Physician Superintendent, Glasgow Fever Hospital, Belvidere.
20. JOHN BRYCE, Assoc. M. Inst., C.E., 17 Peel Street, Partick.
21. JOHN BULLOCH, Insurance Broker, Royal Exchange.
22. HON. G. A. BURNS, 30 Jamaica Street.
23. JAMES CALDWELL, 6 Newton Place.
24. JOHN M. CAMPBELL, F.E.I.S., Kennedy St. Public School, and 14 Royal Crescent, Crosshill.
25. JOHN OLIVER CHISHOLM, Surgeon, 16 Windsor Terrace, St. George's Road.
26. JOHN CLANACHAN, Headmaster, Alexandra Parade School, Dennistoun, 4 Lloyd Street, Dennistoun.
27. JAMES FERGUSON WYLLIE CLARKE, M.A., F.R.C.S.Ed., 24 Buckingham Terrace, Edinburgh.
28. ARCHIBALD COATS, Thread Manufacturer, Woodside, Paisley.
29. JOHN J. COATS, M.A., Writer, 27 Woodside Place.
30. THOMAS COLVIN, M.B., C.M.(Glasg. Univ.), 11 Abbotsford Place.
31. CHARLES BROADFOOT CONNELL, Shipbuilder, Scotstoun Shipbuilding Yard, Whiteinch.
32. JAMES G. CONNELL, 44 St. Enoch's Square.
33. WILLIAM COOK, Writer, 77 St. Vincent Street.
34. THE REV. JAMES COOPER, D.D., Prof. of Church History in Glasgow University, 8 The College.
35. ARCHD. COWIE, East India Merchant, 196 St. Vincent Street.
36. GEO. B. CROOKSTON, Merchant, 188 St. Vincent Street.
37. JOHN S. DICKIE, Shipbroker, 31 St. Vincent Place.
38. ROBERT DOBBIE, Ironfounder, Beechmount, Larbert.
39. P. ALPINE DOCHERTY, L.R.C.P., L.R.C.S.Edin., etc., 526 Springburn Road.
40. JAMES ADDIE DONALD, Merchant, 12 Waterloo Street.
41. DAVID JOHN DUNLOP, Engineer and Shipbuilder, Inch Works, Port-Glasgow, and 198 Bath Street.
42. JOHN DUNLOP, F.E.I.S., Headmaster, Parkhead Public School.
43. JAMES E. DUNN, Timber Broker, 27 Union Street, Glasgow, and Dunmullin, Strathblane.

44. FERGUS FERGUSON, Shipowner and Merchant, 20 Royal Terrace, West.
45. E. BROWN FLEMING, Manufacturer, Mambeg, Dumbartonshire.
46. JAMES H. FLEMING, L.R.C.S.E., L.R.C.P.E., L.F.P.G., 338 Duke Street, Dennistoun.
47. HENRY FORRESTER, Stockbroker, 45 West Nile Street.
48. J. B. FREEBAIRN, M.A., Headmaster, Napiershall Public School.
49. A. PEDEN FYFE, Writer, 135 St. Vincent Street.

50. JOHN R. GARDNER, Grain Miller, 33 Huntly Gardens, Kelvinside.
51. ROBERT GILFILLAN, Springbank Public School, Hinshaw Street.
52. JOSEPH NEWBIGGING GLAISTER, M.B., C.M., 5 Ronald Street.
53. LAWRENCE GLEN, Shipowner, 165 St. Vincent Street.
54. JOHN GORDON, M.D., C.M., 3 Rosebery Terrace, Kelvinbridge.
55. WILLIAM GRAHAM, C.A., 6 Royal Crescent, W.
56. JOHN HATT NOBLE GRAHAM, Merchant, Larbert House, Stirlingshire.
57. WM. EDWARD AULD GRAHAM, Shipowner, 7 Royal Bank Place.
58. GEORGE GREEN, J.P., 40 Balshagray Avenue, Partick.
59. R. O. GRISCHOTTI, Merchant, and Consul for Sweden and Norway, 15 Grosvenor Terrace.
60. DAVID WILLIAM GUTHRIE, 9 Jane Street, Blythswood Square.

61. J. P. HARRINGTON, Broadfield, Port-Glasgow.
62. R. E. S. HARINGTON-STUART (Colonel), Torrance, East Kilbride, N.B.
63. JOHN HARRISON, J.P., 7 Granby Terrace.
64. JAMES R. HODGE, C.A., 105 West George Street.
65. P. S. HONEYMAN, Writer, 12 South Park Terrace.
66. JOSEPH HORNE, M.B., C.M., 5 Windsor Street.
67. J. H. HOULDSWORTH, Rozelle, Ayr.
68. JAMES HUNTER, Nursery and Seedsman, also Warehouseman, 89 Mitchell Street.
69. RICHARD H. HUNTER, Glentyan, Kilbarchan, Renfrewshire.
70. W. K. HUTTON, M.A., M.B., Senior Demonstrator of Anatomy, The University.

71. MALCOLM INGLIS, Leather Factor, 48 St. Andrew Square.
72. GILBERT INNES, 27 Hamilton Drive, Hillhead.

73. THOS. JACKSON, C.A., 24 George Square.
74. ALEX. JOHNSTON, M.D.(Glasg.), D.P.H.(Camb.), Ruchill Hospital.

75. CATHCART KAY, Writer, 77 St. Vincent Street.
76. J. H. KELLY, Van and Lorry Builder, Parkhead.
77. WILLIAM KENNEDY, Railway Contractor, Partick, 13 Victoria Crescent, Dowanhill.

78. GEO. J. KIDSTON, Finlaystone, Langbank.
79. WILLIAM H. KIDSTON, Merchant, 81 Great Clyde Street.
80. JOHANNES N. KIEP, Imperial German Consul, 128 St. Vincent Street.
81. CHAS. M. KING, Antermony House, Milton of Campsie.
82. JOHN KNOX, Schoolmaster, Finnieston School.
83. HUGH LAMBERTON, Managing Director, John Gray & Co., Ltd., Manufacturing Confectioners, Adelphi Terrace.
84. ALEXANDER LAMONT, Headmaster, Kelvinhaugh Public School, 10 Ardgowan Terrace, Sandyford.
85. WILLIAM A. LINDSAY, M.A., B.Sc., Lecturer, F.C. Training College, 4 Lloyd Street, Dennistoun.
86. JOHN KING MACDONALD, J.P., General Manager, The Singer Mfg. Co., Kilbowie, 4 Hillend Gardens, Partickhill.
87. ROBERT MACDOUGALL, F.S.A.A., F.S.I., Accountant and Surveyor, 138 West Regent Street.
88. J. T. C. MACKINLAY, 210 Nithsdale Road, Pollokshields.
89. R. W. MACKINLAY, Metal Merchant and Refiner, 52 Aytoun Road, Pollokshields.
90. NORMAN H. W. MACLAREN, Demonstrator, Zoological Laboratory, University.
91. PETER MACLELLAN, India Rubber Manufacturer, Glasgow Rubber Works, Maryhill.
92. WM. WALTER MACLELLAN, 3 Montague Terrace, Kelvinside.
93. THE REV. DONALD MACLEOD, B.A., D.D., Minister of Park Parish, and Editor of *Good Words*, Author of "Memoir of Norman Macleod, D.D.," "Christ and Society," "Home Service," etc., 1 Woodlands Terrace.
94. JOHN MACNAIR, Warehouseman, 136 Claythorn Street, and 1 Morris Place, Monteith Row.
95. ROBERT MACNEIL BUCHANAN, M.B., C.M., F.F.P.S.G., 9 Burnbank Terrace.
96. ROBERT MACONECHY, Gentleman, Regent Park, Prestwick, Ayrshire.
97. PETER M'BRYDE, M.B., 18 Queen's Crescent, W.
98. ALEXANDER M'DONALD, M.A., 14 Carmichael Place, Langside.
99. ROBERT M'EWEN, Merchant, 11 Park Terrace.
100. A. N. M'GREGOR, M.D., 121 Douglas Street.
101. D. M'KECHNIE, Merchant, 14 Candleriggs.
102. JAMES M'LAY, C.A., 94 Hope Street.
103. CHARLES R. M'LEAN, L.R.C.P.E., L.F.P.S.G., 15 Annfield Place, Dennistoun.
104. JAMES N. M'RAITH, Teacher, 4 Queen Square, Strathbungo.
105. JAMES MANN, Merchant, 4 University Gardens.
106. ROBERT M. MANN, Warehouseman, 3 Montgomerie Crescent.
107. JAMES MARSHALL, Woodcroft, Crow Road, Partick.

108. ROBT. MARSHALL, 97 Wellington Street.

109. JOHN MARR, J.P., Property Agent and Valuator, Dunjarg, Bellahouston, Govan.

110. J. MAXTON, 27 Cedars Road, Clapham Common, London, S.W.

111. JOHN MILLER, M.D., 323 Springburn Road.

112. ALEXANDER MUNRO, M.B., C.M., 569 Gallowgate.

113. JAMES NAPIER, M.A., F.R.S.E., The Drums, Old Kilpatrick.

114. WALTER NEILSON, Greenfield, Ayr.

115. THOMAS C. NELSON, Commission Agent, Craiglea, Dennistoun.

116. ROBERT HENRY PARRY, F.R.C.S.E., 3 Royal Crescent, Queen's Park.

117. WILLIAM PATERSON, Physician and Surgeon, 43 Millbrae Road, Langside.

118. JOSEPH PATRICK, of Alex. Kay & Co., Insurance Broker, Royal Exchange Buildings.

119. JOHN PINKERTON, M.D., Q.H.P., Surgeon-General, Queen's Park House, Langside.

120. WILLIAM HENRY RALSTON, 4 North Court, Royal Exchange.

121. G. G. RAMSAY, LL.D., Litt. D., Prof. of Humanity in Glasgow University, 6 The College.

122. THE REV. W. M. RANKIN, B.D., Clergyman, 8 Craigpark, Dennistoun.

123. ANDREW THOMSON REID, Engineer, 10 Woodside Terrace.

124. R. A. RIGG, Merchant, 95 Buchanan Street.

125. ALEX. ROBERTSON, M.D., F.F.P.S.G., 11 Woodside Crescent.

126. ROBERT ROBERTSON, B.Sc., M.Inst.C.E., M.I.E.E., etc., 154 West George Street.

127. WILLIAM ROBERTSON, 15 Gordon Street.

128. C. H. ROEMMELE, Merchant, 34 Kelvinside Gardens.

129. HUGH ROSE, Papermaker, 26 Eglinton Drive.

130. WM. F. RUSSELL, Coal Exporter, 48 West Regent Street: Residence 2 Derby Crescent.

131. B. SANDEMAN, Ferndean, Lenzie.

132. ALEXANDER SCOTT, M.D., Waverley Lodge, Tollcross, and 12 Renfield Street.

133. HERMANN LEO SELIGMANN, Jun., 28 Renfield Street.

134. R. GIBSON SERVICE, Marine Insurance Broker, 14 Royal Exchange Buildings.

135. WILLIAM SERVICE, Shipowner, 1 Queen's Gate, Dowanhill.

136. J. B. SHANKS, Foreign Merchant, 46 Gordon Street.

137. COUNCILLOR A. M'INNES SHAW, Ironfounder, 8 Kelvinside Terrace, North.

138. WILLIAM SHAW, Solicitor, 17 Woodside Crescent.

139. GEO. SHERRIFF, Carronvale, Larbert, Stirlingshire.

140. DANIEL SHIELDS, 104 West George Street.
141. WILLIAM SIMONS, M.I.N.A., Sherbrook, Tighnabruaich, Argyllshire.
142. GEORGE SLOAN, Shipowner, 53 Bothwell Street.
143. SAMUEL SLOAN, M.D., 5 Somerset Place.
144. COLONEL J. N. SMITH, V.D., 2 Meadowbank Crescent, Partick.
145. LIEUT-COLONEL JAMES SMITH PARK, Shipowner, 61 Hamilton Drive.
146. PATRICK A. SMITH, M.D., F.F.P.S.G., J.P., Dundrennan, 50 Queen Mary Avenue, Crosshill.
147. J. F. SNODGRASS, Miller and Flour Merchant, Ashbourne, Winton Drive, Kelvinside.
148. HENRY STEVEN, Wholesale Grocer, 20 Ingram Street.
149. GEORGE STRACHAN, Secretary of Public Company, Fairfield Works, Govan.
150. JAS. M. STRAIN, Coalmaster, 11 Hillend Gardens.
151. J. M. TAYLOR, Dean of Faculty of Procurators, Northbank, Kelvinside.
152. JAMES TEMPLETON, Manufacturer, 2 Claremont Terrace.
153. JOHN STEWART TEMPLETON, Carpet Manufacturer, William Street.
154. ALEXANDER THOMSON, M.B., C.M., Edin., 8 Hamilton Park Terrace, Hillhead.
155. GEORGE THOMSON, Schoolmaster, Tureen Street Public School.
156. JOHN TULLIS, Leather Manufacturer, John Street, Bridgeton.
157. WILLIAM H. WALKER, Coalmaster, Cardarroch House, Airdrie.
158. JAMES WILSON WALLACE, M.D., C.M., Cairnsmore, 67 St. Andrew's Drive, Pollokshields.
159. WILLIAM WALLACE, M.A., LL.D., Barrister-at-Law, and Author, 36 Lilybank Gardens, W.
160. ALEXANDER WATT, 183 St. Vincent Street.
161. COUNCILLOR H. CARVICK WEBSTER, 48 Montgomerie Drive.
162. JOHN LAURIE WHYLE, 5 Mansion House Road, Langside.
163. JAMES WOOD, Headmaster, Dunard Street Public School, 2 Cresswell Terrace, Uddingston.
164. ALEXANDER WOODROW, 75 Glassford Street.
165. ALEXANDER NORIE WOODROW, Lithographer, 75 Glassford Street.
166. JAMES WYPER, Wine Merchant, Nithsdale Lodge, Pollokshields.
167. DAVID YOUNG, M.D., Linton Villa, Tollcross Park.
168. JOHN YOUNG, Merchant, 8 Athole Gardens, Kelvinside.

19th December, 1900.

The Fourth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 19th December, 1900, at eight o'clock. In the absence of the President, Professor John Glaister, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 5th December, 1900, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. A letter of apology for absence from the President, Lord BLYTHSWOOD, was read to the Meeting. Apologies were intimated from Colonel R. E. S. Harrington-Stuart; Mr. Archibald Coats, Paisley; Mr. William Kennedy, Dowanhill; Mr. Robert Dobbie, Larbert; Mr. Matthew Arthur, Queen Street; Mr. J. Arthur, Queen Street; Mr. Charles M. King, Milton of Campsie; Dr. Alex. Thomson, Hillhead; Mr. J. H. Houldsworth, Ayr; Dr. Joseph N. Glaister, Glasgow; Mr. John S. Templeton, William Street; The Hon. G. A. Burns; Mr. Charles B. Connell, Whiteinch; Mr. Wm. R. Broadfoot, Whiteinch; Mr. Wm. E A. Graham, Royal Bank Place; Mr. Joseph Patrick, Royal Exchange Buildings; Mr. Robert Maconechy, Prestwick; Mr. Archd. Cowie, St. Vincent Street; Mr. A. M. Brown, West Nile Street; Mr. David W. Guthrie, Blythswood Square; Mr. William H. Kidston; Mr. John S. Dickie, St. Vincent Place; and Mr. D. Shields, West George Street.

3. Of the New Members elected at last Meeting, those present were formally received, and the others held as admitted Members of the Society.

4. Professor Hugh Galt, M.B., D.P.H. (Camb.), read a Paper entitled, "Some Points in the Analysis of Meat Extracts, and Allied Preparations," being a contribution from the Sanitary and Social Economy Section.

The Chairman made a few appreciative remarks on the Paper read, and on his motion a hearty vote of thanks was awarded to Professor Galt.

5. Professor Glaister then left the Chair, which was thereupon taken by Mr. John F. Campbell, Vice-President.

6. Professor Alexander Maclay, B.Sc., C.E., read a Paper, illustrated by numerous lime-light views, on "Technical Colleges in Germany and in Glasgow." A discussion followed, in which part was taken by Mr. W. W. Blackie and Professor Magnus Maclean. Professor MacLay was accorded a hearty vote of thanks on the motion of the Chairman.

7. The next business on the Agenda was a Paper by Mr. James S. Dunlop, B.A.(Camb.), M.A., B.Sc., entitled, "The Non-Elastic Deformation of Copper Wire under Various Stresses," being a contribution from the Mathematical and Physical Section.

As the two preceding Papers were of considerable length, it was agreed that Mr. Dunlop's communication should be held as read at that Meeting, for purposes of priority of publication.

8. It was announced that the following gentlemen had been duly elected Members of the Society :—

1. THOMAS G. ARTHUR, Merchant, Carrick House, Ayr.
2. ALEXANDER BALFOUR, Kelvindare, Kelvinside.
3. THOMAS BIGGART, Writer, 105 West George Street.
4. WILLIAM DUNN BLACK, J.P., Auchentoshan, Dalmuir.
5. WM. BURRELL, 54 George Square.
6. DAVID S. CARGILL, 9 Park Terrace.
7. GEORGE MUIR CONNOR, M.B., C.M., 574 Gallowgate.
8. JAMES S. DIXON, Fairleigh, Bothwell.
9. JOHN DUNLOP, M.D., 1 Somerset Place.
10. MATTHEW DUNLOP, Merchant, 7 Clairmont Gardens.
11. JOHN C. EDMISTON, M.D., 6 Wilton Gardens.
12. JOHN FLEMING, Writer, 241 St. Vincent Street.
13. N. B. GUNN, Manager of the Scottish Amicable Life Assurance Society, 35 St. Vincent Place.
14. JOHN GUMPRECHT, Merchant, 4 West Regent Street.
15. THOMAS HENDERSON, 1 Lancaster Crescent, Kelvinside.
16. JOHN KNIGHT, M.B., C.M., D.P.H., 2 Clydeford Drive, Tollcross.
17. T. W. M'INTYRE, Shipowner, 21 Bothwell Street.
18. ALEX. LAMBERTON, 8 Adelphi Terrace.
19. R. D. MACGREGOR, 7 Windsor Circus, Kelvinside.
20. JOHN ALEXANDER MACKENZIE, M.B., C.M., 4 Carmichael Place, Langside.
21. DUNCAN MACPHERSON, Headmaster, Rosemount School.

22. ALEXANDER WINGATE MILLER, Merchant, 79 West Nile Street.
23. JAMES MILLER, 5 Hanover Street.
24. J. C. MILLER, 40 West Nile Street.
25. JOHN NEILSON, Mollance, Castle-Douglas.
26. JOHN E. NELSON, Merchant, 26 Queen Street.
27. A. G. PALGRAVE, 17 Wilton Mansions, Kelvinside, N.
28. JAMES POWELL, Newlands School.
29. ROBERT REID, C.A., 40 St. Vincent Place.
30. WILLIAM ROBB, F.R.C.V.S., 6 Canning Place, Stirling Road.
31. GEORGE SMITH, Bank Agent, 1 Annfield Terrace, East Partick.
32. ALEX. WARDLAW, Assist. Manager, The Clydesdale Bank, Ltd.
33. J. WALLS WHITE, M.D., Brunalb, Uddingston.
34. JAMES YOUNG, Jun., Caerleon, Bearsden.
35. JOHN E. YOUNG, Manufacturer, 24 Belhaven Terrace, Kelvinside.
36. HARRY LUMSDEN, M.A., LL.B., Writer, 105 West George Street.

9th January, 1901.

The Fifth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 9th January, 1901, at eight o'clock. In the absence of the President, Mr. Paul Rottenburg, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 19th December, 1900, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absence were received from Mr. Thomas G. Arthur, Ayr; Mr. David S. Cargill, Park Terrace; Mr. Alexander Lamberton, Adelphi Terrace; and Mr. John Neilson, Castle-Douglas.

3. Of the New Members elected at last Meeting, those present were formally received, and the others held as admitted Members of the Society.

4. Professor John Ferguson, M.A., LL.D., F.R.S.E., of Glasgow University, read a paper on "The Chemical Work of Christopher Glaser."

On the motion of the Chairman, Professor Ferguson was accorded a hearty vote of thanks.

5. The Chairman explained that owing to the incompleteness of some of the apparatus necessary for the experiments, Mr. Craw was not able to give his promised paper on "The Determination of Surface Tensions of Liquids by means of Ripples," that evening, but would read it, by arrangement, on the 6th March instead, and that Professor Gray would make a communication to the Meeting on some scientific investigations in which he was engaged.

Professor A. Gray, LL.D., F.R.S., of the University then gave a lecture on "The Viscosity of Metals, the Resistance of Iron in a Magnetic Field, and the Viscosity of a Magnetic Liquid in a Magnetic Field."

Discussion followed in which part was taken by Mr. R. F. Muirhead and Professor Gray. The Chairman said they must feel especially indebted to Professor Gray for his kindness in agreeing to lecture to the Society on the shortest notice, as well as for the interesting communication he had made, and moved a vote of thanks to the Lecturer, which was cordially responded to.

6. It was announced that the following gentlemen had been duly elected Members of the Society :—

1. C. E. MACAULAY (Colonel), 2 Cathedral Square.
2. SAMUEL MARKS, 145 Great Eastern Road.
3. Professor ALEX. MACLAY, B.Sc., C.E., Camptower, Bearsden.
4. DAVID JAMES PLAYFAIR, 7 Victoria Crescent, Dowanhill.
5. FRED J. SMITH, Stockbroker, 40 St. Vincent Place.
6. WM. THOS. HOULDSWORTH, Clerk in Holy Orders, 1 Mansfield Street, Portland Place, London, W.
7. WM. BROWN, F.S.A.A., F.S.I., Accountant and Surveyor, 138 West Regent Street.
8. WILLIAM WEIR, Ironmaster, Shewalton, Dreghorn.

23rd January, 1901.

The Sixth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 23rd January, 1901, at eight o'clock. In the absence of the President, Mr. John F. Campbell, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 9th January, 1901, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absence were received from Colonel C. E. Macaulay, Glasgow; the Rev. Wm. T. Houldsworth, London; and Mr. David J. Playfair, Dowanhill.

3. The Chairman intimated that there would be no formal reception of New Members that evening, but that those elected at last meeting, would be held as admitted and their Diplomas forwarded by post.

4. The Hon. Secretary announced that the following gentlemen had been duly elected Members of the Society :—

1. R. P. GRIER, 54 Newark Drive, Pollokshields.
2. HUGH LAMBERTON, Lylestone, Pollokshields.
3. Dr. ROBERT H. FLEMING, Surgeon, 19 Newton Street, Charing Cross.
4. ROBERTSON BUCHANAN STEWART, Warehouseman, 146 Argyle Street, and "Dunavon," Strathaven, Lanarkshire.
5. DAVID M'KAIL, M.B., Ch.B., 483 London Road.
6. GEORGE MELVILLE, Commission Merchant, 14 Princes Square.

5. The Hon. Secretary on behalf of the Council moved the suspension of the Standing Orders, so that a motion might be made from the Chair in connection with the death of Her Majesty the Queen. This having been agreed to, the Chairman then moved—

"That, in consequence of the death of Her Majesty the Queen, this Meeting of the Philosophical Society of Glasgow do now adjourn, and remit to the President, the Right Hon. The Lord Blythswood, to convey to His Majesty the King and the other Members of the Royal Family, an expression of the Society's deepest and most respectful sympathy."

The motion, which was received by the Members upstanding, was unanimously agreed to, and the meeting forthwith adjourned.

6th February, 1901.

The Seventh Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 6th February, 1901, at eight o'clock. In the absence of the President, Mr. John F. Campbell, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 23rd January, 1901, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absence were received from Dr. R. H. Fleming, Mr. George Melville, and Dr. M'Kail.

3. The gentlemen elected at the previous Meeting were admitted Members of the Society.

4. George Neilson, Esq., Procurator-Fiscal, read a paper entitled, "Sir Hew of Eglintoun and Huchown off the Awle Ryale: a Biographical Calendar and Literary Estimate."

A disussion followed in which Dr. Colville, Mr. John Edwards, Mr. Barrett, and Dr. Fergus took part; and on the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Neilson.

5. The Chairman announced that the following gentlemen had been elected to the Membership of the Society:—

1. F. BAUERMEISTER, Foreign Bookseller, 49 Gordon Street.
2. W. BEARDMORE, Parkhead Forge.
3. MATTHEW BLACKWOOD, Timber Merchant, Ardmore, Port-Glasgow.
4. ALEX. BRUCE, Timber Merchant, Clyne House, Pollokshields.
5. JAS. T. FARQUHAR, Grain Merchant, 47 Hope Street.
6. DAVID FERGUSON, Shipbuilder, Glenholm, Port-Glasgow,
7. ROBERT FORRESTER, Coalmaster, 142 West Nile Street.
8. JOHN GRAY, Millowner, 181 Renfrew Street.

20th February, 1901.

The Eighth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 20th February, 1901, at eight o'clock. In the absence of the President, Mr. John F. Campbell, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 6th February, 1901, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absençe were received from Colonel Harington-Stuart and Dr. Fullerton.

3. The gentlemen elected at the previous Meeting were admitted Members of the Society.

4. The Rev. Donald Fraser of the Livingstonia Mission, read a paper on "The Zulu of Nyasaland—their Manners and Customs," with lime-light illustrations, being a contribution from the Geographical and Ethnological Section.

Discussion followed, in which part was taken by Mr. Moir of the African Lakes Corporation, Mr. James Knight, and Mr. Fraser.

A hearty vote of thanks was accorded to the Rev. gentleman on the motion of the Chairman.

5. The Chairman announced that the following gentlemen had been elected Members of the Society:—

1. ROBERT LOCKE ANDERSON, Decorator, 233 St. Vincent Street.
2. ROBERT ANGUS, Ironmaster, Lugar, Ayrshire, N.B.
3. JOHN ARMOUR BROWN, Moredun, Paisley.
4. THOMAS MATHIESON BROWN, Coalmaster, Ardnith House, New Cumnock, Ayrshire.
5. PETER BUCHANAN, Merchant, 7 Garthland Street.
6. Rev. ROBERT BUCHANAN, B.D., Minister of Prestonfield Church, Edinburgh, 28 Queen's Crescent, Edinburgh.
7. WALTER BUCHANAN, Solicitor, Clerkhill House, Dumbarton.
8. JAMES MURDOCH CAMPBELL, Pastry Baker, 147 George Street.
9. JOHN CAMPBELL, Coppersmith, 49 St. Andrew's Drive, Pollokshields.
10. JAMES CANT, Timber Broker, Woodholm, Bridge-of-Weir.
11. HERBERT ROBIN CAYZER, Shipowner, Ralston, Renfrewshire.
12. JAMES WILLIAM CLELAND, Barrister-at-Law, 1 Elm Court, Temple, London, E.C.
13. MICHAEL JOSEPH CONNELL, B.A., LL.B., Solicitor, 17 Holmhead Street.
14. ROBERT ALEXANDER CRUIKSHANK, J.P., Shipowner, Ardbeg, Kilmun.
15. ALEX. CULLEN, F.R.S.E., F.R.I.B.A., Millburn, Dalserf, by Netherburn.
16. HUGH SHAW DUNN, Earlston Villa, Caprington, Kilmarnock.
17. JOHN FAILL, Contractor, 7 Winton Drive, Kelvinside.

18. JOHN GARDNER, Ironmonger, 146 Trongate.
19. ROBERT GLEN, Carlston, Kelvinside.
20. JOHN WILLIAM GRAVES, Hydropathic, Kilmalcolm.
21. JOHN GUTHRIE, Managing Director, L. Sterne & Co., Ltd. (The Crown Iron Works, Glasgow), 17 Whittinghame Drive, Kelvinside.
22. PETER WISHART HALL, Rosin Distiller and Printing Ink Manufacturer, Kyle Street, Dobbie's Loan.
23. WILLIAM HYSLOP, Coalmaster, of Bank, New Cumnock.
24. JAMES GRAHAM JENKINS, Iron, Steel and Iron-ore Merchant, Airedale, Cambuslang.
25. THOMAS JENKINS, Merchant, Woodlands, Crosshill.
26. ROBERT LAMBIE, Strathview, Larkhall.
27. JOHN LARGE, Insurance Manager, Norwich Union Chambers, St. Vincent Street.
28. THOMAS LAWSON, Birchgrove, Pollokshields.
29. WILLIAM LOVE, Merchant, 28 Royal Exchange Square.
30. THOMAS RIACH MACKENZIE, General Manager and Secretary of the Clyde Navigation Trust, 16 Robertson Street.
31. ANDREW K. M'COSH, Iron and Coal Master, Cairnhill, Airdrie.
32. ALEXANDER BEITH M'DONALD, M.Inst. C.E., City Engineer, City Chambers.
33. JOHN WILLIAM M'LAREN, 134 St. Vincent Street.
34. JAMES MACNAB, Lillyburn, Milton of Campsie, Stirlingshire.
35. ANDREW DUNCAN MACNAIR, Manufacturer, Benvue, Dowanhill Gardens.
36. MATTHEW MACNAIR, Warehouseman, 1 Morris Place, Monteith Row.
37. MATTHEW GREENLEES MUIR, Coal Exporter, 12 Waterloo Street.
38. JOHN MURDOCH, Writer, 208 West George Street.
39. ARCHIBALD GARIBALDI NEILSON, 11 Bothwell Street, or 9 Hillside Gardens, Partickhill.
40. JOHN ORR, Decorator, 107 Wellington Street.
41. ROBERT PROCTER, Manufacturer, Claremont, Alloa.
42. ADAM RANKINE, Director, Russell, Macfarlane & Co., Ltd., 47 Queen Street.
43. JOSEPH REID, Iron and Steel Merchant, 32 Newark Drive, Pollokshields.
44. JOHN RENNIE, Wellcroft, Helensburgh.
45. WILLIAM RENWICK, Engineer, Langgarth, Stirling.
46. Rev. ALEXANDER ROBINSON, M.A., B.D., Auchengray, Crieff.
47. THOMAS ROBINSON, Chemical Manufacturer, The Villas, Hurlet, Nitshill.
48. JAMES RUSSELL ROSS, Manager, Parkhead Steel Works, 8 Ashfield Gardens, Jordanhill.
49. EDWARD SERVICE, Stockbroker, 92 St. Vincent Street.
50. ROBERT SCOTT, Goldsmith, 8 Buchanan Street.

51. ANDREW SMITH, Drysalter and Gum Manufacturer, Miltonlea, Kilmalcolm.
52. ALLAN ALFRED STEWART, Solicitor, 180 Hope Street.
53. DUNCAN STEWART, Engineer, 14 Windsor Terrace, Kelvinside.
54. Rev. JOHN M'KESSOR WEBSTER, M.A., The Manse, Row, Dumbartonshire.
55. THOMAS WILSON, Writer, 142 West George Street.
56. THOMAS F. WILSON, Writer, 129 St. Vincent Street.
57. WALTER STUART WILSON, Civil Engineer, 4 St. John's Terrace.
58. JOHN WILLIAM WOYKA, Timber Merchant, 241 Govan Street.
59. WILLIAM A. WYLIE, Merchant, 13 Woodside Terrace.

27th February, 1901.

A Special Meeting of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 27th February, 1901, at eight o'clock. William Ewing, Esq., President of the Geographical and Ethnological Section occupied the Chair.

1. Dr. John Ross, of Manchuria, delivered a lecture, illustrated by lime-light views, on "The Chinese People and their Religions." The lecture was a contribution from the Geographical and Ethnological Section.

A discussion followed in which part was taken by Professor Glaister, Mr. Gibbs, Professor Workman, and Mr. Falconer.

Dr. Ross replied, and on the motion of the Chairman was accorded a hearty vote of thanks.

6th March, 1901.

The ninth Ordinary Meeting for Session, 1900-1901, of the Philosphical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 6th March, 1901, at eight o'clock. In the absence of the President, Mr. John F. Campbell, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 20th February, 1901, and the Minute of Special Meeting of date, 27th February, 1901, having been printed in the Billet calling the Meeting, were held as read, were approved, and were signed by the Chairman.

2. The gentlemen elected at the previous Meeting were admitted Members of the Society.

3. Mr. J. A. Craw read a paper entitled "The Determination of Surface Tensions of Liquids by Means of Ripples," being a contribution from the Mathematical and Physical Section. The paper was illustrated by lanterns views and experiments. A discussion followed in which part was taken by Mr. Galloway and Mr. John F. Campbell.

A hearty vote of thanks was accorded to Mr. Craw on the motion of Mr. Galloway, seconded by the Chairman, who informed the Meeting that they were under a special obligation to the lecturer as he was not yet recovered from a serious illness, but had ventured out rather than disappoint the Society.

4. The Chairman announced that the following gentlemen had been elected Members of the Society :—

1. HERBERT STANLEY ALLEN, M.A., B.Sc., Blythswood Laboratory, Renfrew.
2. ALLEN ARNEIL, Educational Representative, 13 Afton Crescent.
3. NICOL PATON BROWN, 22 Belhaven Terrace.
4. JOHN AGNEW, Coalmaster, Viewfield House, Carluke.
5. JOHN BARNET, Manufacturer, 55 Oswald Street.
6. JOHN BAXTER, I.M., Measurer and Valuator, 243 St. Vincent Street.
7. JOHN GILLESPIE BORLAND, Coal Exporter, 93 Hope Street.
8. WILLIAM RAMSAY CALDER, Timber Broker, 102 Hope Street.
9. WILLIAM DAILING, Coalmaster, 178 St. Vincent Street.
10. THOMAS DICK, County Councillor, Property and Insurance Manager, 166 St. Vincent Street, (Residence—Lochhead House, Pollokshields.)
11. JAMES DUTHIE, Paint Merchant, 129 St. Vincent Street.
12. JOHN FARRELLY, Merchant, 25 Elmbank Crescent.
13. WILLIAM FIFE, Jr., Naval Architect, Fairlie, Ayrshire.
14. COLLINGWOOD FLOWER, of Rockvilla Old Mills, The Hermitage, Drumchapel.
15. JOHN GARDINER, Merchant, 18 Gibson Street, Hillhead.
16. GEO. GARRETT, Iron Manufacturer, Dunbeth Lodge, Coatbridge.
17. WILLIAM GILLIES, Writer, Shawlands House.
18. THOMAS ARTHUR GREER, Cashier, Fairfield Works, Govan.
19. WILLIAM THOMAS HAY, Writer, Silverwells, Hamilton.
20. FRANCIS HENDERSON, Shipowner, 47 Union Street.

21. ARCHIBALD J. HOOD, M.A., 2 Kelvingrove Terrace.
22. ROBERT HUNTER, Merchant, 72 Waterloo Street.
23. JOSEPH HUTCHISON, Woodside, Netherburn, Lanarkshire.
24. JOHN DAVIDSON KELLY, M.A., Stanley House, Bridge-of-Allan.
25. ALEXANDER KELLY, 100 Hyde Park Street.
26. MOSES HUNTER KENNEDY, Contractor, 217 West George Street.
27. DAVID LAUGHLAND, Bank Agent, 11 Newton Terrace.
28. JAMES H. LAW, Brandon House, Ibrox.
29. WILLIAM LEE, M.A., F.E.I.S., Teacher, 298 Cumbernauld Road.
30. FRANCIS GLEN MACANDREW of Knock, Knock Castle, Largs.
31. MUDIE MACARA, 1 Belmont Street.
32. JAMES MACARA, Grain Merchant, 19 Waterloo Street.
33. JOHN M'ELLIGOTT, 4 Victoria Drive, Mount Florida.
34. DUGALD MACLACHLAN, B.L., Solicitor, 28 Renfield Street.
35. JOHN RAMSAY METCALFE, Property and Insurance Agent, 19 Montgomery Quadrant.
36. THOMAS M'MICHAEL, M.A., 54 Windsor Street.
37. ROBERT M'MILLAN, Shipbuilder, Methlan Park, Dumbarton.
38. ROBERT M'NISH, Wine Merchant, 14 Carrick Street.
39. ALEXANDER BROWN MITCHELL, Bleacher, Avon Bank House, Larkhall.
40. DONALD MACKAY MUNRO, Stockbroker, 88 St. Vincent Street.
41. JAMES MONRO NICOL, Merchant and Shipowner, 93 Cheapside Street.
42. NICHOLAS M'WHIRTER REID, 40 Whitehill Street, Dennistoun.
43. THOS. ROWLEY, Silk Finisher and Dyer, Campbell Street, Govan.
44. HENRY TOD ROBERTSON, Meadowbank, Airdrie.
45. ROBERT RUSSELL, M.E., Managing Director Coltness Iron Co., Ltd., Newmains, Lanarkshire.
46. JOHN SMITH SAMUEL, Secretary to the Lord Provost of Glasgow, City Chambers.
47. WM. SHEARER, 108 St. Vincent Street.
48. JAMES MURRAY SMITH, Newspaper Editor, 11 Bute Gardens.
49. JOHN ALLAN WALKER, Art Master, Allanbank, Abbey Drive, Jordanhill.
50. JOHN LOCKHART STERLING, 30 Ashton Gardens.
51. HAROLD WATSON, 9 Holland Place.
52. ROBERT GOW WATSON, 13 Bruce Road, Pollokshields.
53. ARTHUR WHITSON, Writer, 77 St. Vincent Street.
54. ADAM WOOD, Coal and Ironmaster, Portland Villa, Troon.
55. JOHN YOUDEN, Merchant. 12 Bothwell Street, Glasgow, and Hazelwood, Giffnock.
56. JOHN WEIR YUILL, Bleacher and Finisher, Glenmill House, Campsie Glen.

10th March, 1901.

The Tenth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 20th March, 1901, at eight o'clock. In the absence of the President, Professor John Glaister, Vice-President, occupied the Chair.

1. The Minute of previous Meeting, of date 6th March, 1901, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absence were intimated from Mr. Thomas A. Greer, Mr. Francis Henderson, Mr. John D. Kelly, Mr. Francis G. MacAndrew, Mr. James Macrae, Mr. Thomas Rowley, Mr. James M. Smith, and Mr. Robert G. Watson.

3. The gentlemen elected at the previous Meeting were admitted Members of the Society.

4. Professor Glaister then vacated the Chair, which was taken and occupied for the rest of the evening by Mr. Gilbert Thomson, President of the Sanitary and Social Economy Section.

5. Professor Glaister read a paper entitled "Sewage Disposal and Sewage Purification," being a contribution from the Sanitary and Social Economy Section.

In the discussion which followed, part was taken by Mr. James Knight, Mr. Melvin, Mr. P. Fyfe, Mr. Hogg, Mr. Frew, Mr. Barrett, Mr. Gillies, and the Chairman.

Professor Glaister replied, and a hearty vote of thanks was accorded to him on the motion of the Chairman.

6. The Hon. Secretary announced that the following gentlemen had been elected Members of the Society:—

1. WILLIAM G. JOHNSTON, Chemical Manufacturer, 18 Coatbridge Street, Port Dundas.
2. JAMES FRASER, Manufacturer, 53 Queen Mary Avenue, Crosshill.
3. JAMES GORDON, Stonebyres, 14 Aytoun Road, Pollokshields.
4. JOHN MARTIN, Writer, 58 West Regent Street.
5. THOMAS MACKENZIE MORRISON, M.A., Lecturer U.F. Church Training College, 4 Hillend Gardens, Partickhill.
6. ROBERT DAVIDSON WADDELL, Rednock, Kelvinside, W.
7. GEORGE LOUDEN WATSON, Coalmaster, 109 Hope Street.

3rd April, 1901.

The Eleventh Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 3rd April, 1901, at eight o'clock. In the absence of the President, Mr. John Mann, Jun., President of the Economic Science Section, occupied the Chair.

1. The Minute of previous Meeting, of date 20th March, 1901, having been printed in the Billet calling the Meeting, was held as read, was approved, and was signed by the Chairman.

2. Apologies for absence were intimated from Mr. R. D. Waddell and Mr. G. L. Watson.

3. The gentlemen elected at the previous Meeting were admitted Members of the Society.

4. The Chairman introduced Mr. R. P. Lamond, and intimated that, by arrangement, the paper by Dr. Marr on the billet for that evening was reserved for a special meeting.

5. Mr. R. P. Lamond then read a paper entitled "Municipal Trading," being a contribution from the Economic Science Section.

A long discussion followed the reading of the paper, in which Mr. Woyka, Councillor Bruce-Murray, Bailie Stevenson, Mr. Handasyde Dick, Mr. M'Laren, Councillor Erskine, Mr. Kelly, Mr. Todd and the Chairman took part.

On the Chairman's motion a hearty vote of thanks was accorded to Mr. Lamond.

6. The Chairman announced that the following gentlemen had been elected Members of the Society:—

1. The Right Hon. LORD BELHAVEN and STENTON.
2. JAMES BOYCE, 106 West Nile Street.
3. GEORGE ROBB, Carting Superintendent, Caledonian Railway.
4. WILLIAM STEWART, Timber Merchant, Kelvinhaugh Street.

17th April, 1901.

The Twelfth Ordinary Meeting, for Session 1900-1901, of the Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 17th April, 1901, at eight o'clock. In the absence of the President, Mr. John Mann, Junr., President of the Economic Science Section, occupied the Chair.

1. The Minute of previous Meeting, of date 3rd April, 1901, and the Minute of Special Meeting of date, 10th April, 1901, having been printed in the Billet calling the Meeting, were held as read, were approved, and were signed by the Chairman.

2. The gentlemen elected at the previous Meeting were admitted Members of the Society.

The Right Hon. Lord Belhaven and Stenton was present and entered his name on the Roll of the Society.

3. The Chairman then introduced Mr. John Galloway who read a paper, entitled—"Trusts and Combines," being a contribution from the Economic Science Section.

A discussion of considerable length followed the reading of the paper in which part was taken by Mr. Beckett, Mr. Guthrie, Professor Elliot, Mr. Handasyde Dick, Mr. Stewart, Mr. Macindoe, Dr. Snodgrass, Mr. Barclay, Mr. M'Laren, Mr. John A. Todd, the Chairman, and Mr. Galloway.

A hearty vote of thanks was accorded to Mr. Galloway, on the motion of the Chairman.

4. The Chairman announced that:—

1. EDWARD MACBEAN, F.R.G.S, F.R.S.L., Rannochlea, St. Andrew's Drive, Pollokshields.
2. JAMES MURRAY, Bank Teller, 144 Craigpark, Dennistoun.

had been duly elected Members of the Society.

The Acting Secretary then read this Minute, which was approved; and the Chairman was authorised by the Meeting to sign it when engrossed in the Minute-Book.

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Royal Photographic Society, 5a Pall Mall, East.
Royal Society, Burlington House.
Royal Statistical Society, 9 Adelphi Terrace, Strand.
Society of Arts, John Street, Adelphi.
Society of Biblical Archæology, 37 Great Russell Street, Bloomsbury.
Society of Chemical Industry, Palace Chambers, 9 Bridge Street, Westminster.
Society of Engineers, 17 Victoria Street, Westminster.
Society of Psychical Research, 19 Buckingham Street.
Engineering. The Publisher, 35 Bedford Street, Strand.

Manchester—

Manchester Association of Engineers, Grand Hotel Aytoun Street.
Geographical Society, 16 St. Mary's Parsonage.
Literary and Philosophical Society of Manchester, 36 George Street.

Middlesborough—

Cleveland Institution of Engineers.

ENGLAND AND WALES—*continued.*

Newcastle-upon-Tyne—
North-East Coast Institution of Engineers and Shipbuilders, 4 St. Nicholas Buildings.
North of England Institute of Mining and Mechanical Engineers, Neville Hall.

Oxford—
Bodleian Library.

Stratford (Essex)—
Essex Field Club. Passmore-Edwards Museum, Romford Road.

Truro—
Royal Institution of Cornwall.

Watford—
Hertfordshire Natural History Society and Field Club, Herga. D. Hill, Hon. Librarian.

Welshpool—
Powys Land Club. The Secretaries, Museum and Library, Salop Road.

FRANCE.

Bordeaux—
Société des Sciences Physiques et Naturelles.

Marseilles—
Faculté des Sciences de Marseille.

Paris—
Ecole Polytechnique. The Director.
Observatoire Météorologique Central de Montsouris.

GERMANY.

Berlin—
Deutsche Chemische Gesellschaft.
Deutsche Kolonial Verein.
Königliche Preussische Akademie der Wissenchaften.

Bremen—
Geographische Gesellschaft.

Giessen (Hesse)—
Oberhessische Gesellschaft für Natur-und-Heilkunde.

Griefswald (Prussia)—
Geographische Gesellschaft.

Halle (Prussia)—
Verein für Erdkunde.
Kaiserliche Leopoldino—Carolinische Deutsche Akademie der Naturforscher.

INDIA.

Calcutta—
Geological Survey of India.

IRELAND.

Belfast—

Belfast Naturalists' Field Club, Museum, College Square, North.

Natural History and Philosophical Society, Museum, College Square, North.

Dublin—

Royal Dublin Society, Leinster House.

Royal Irish Academy, 19 Dawson Street.

Trinity College Library.

ITALY.

Milan—

Reale Instituto di Lombardo di Scienze, Lettere, ed Arti.

JAPAN.

Tokio—

Imperial University of Tokio, Science College.

Imperial University of Tokio.

MEXICO.

Mexico—

Observatorio Astronómico Nacional de Tacubaya.

Sociedad Cientifica "Antonio Alzate."

NEW ZEALAND.

Wellington—

Colonial Museum.

NETHERLANDS.

Amsterdam—

Académie Royale des Sciences à Amsterdam.

Harlem—

Société des Sciences à Harlem.

Leyden—

Kon. Nederlandisch Aardrijkskundig Genootschap.

NORWAY.

Christiania—

Kongelige Norske Frederiks Universitet.

ROUMANIA.

Bucharest—

Societatiĭ de Sciinte Fizice.

RUSSIA.

Kazan—

Imperial Kazan University.

St. Petersburg—

Académie Impériale des Sciences.

Russian Chemical Society of the University of St. Petersburg.

SCOTLAND.

Aberdeen—
Philosophical Society, 147 Union Street.

Edinburgh—
Advocates' Library.
Botanical Society of Edinburgh, Royal Botanic Garden.
Geological Society, 5 St. Andrew Square.
Highland and Agricultural Society of Scotland, 3 George IV. Bridge.
Royal Physical Society, 18 George Street.
Royal Scottish Geographical Society, Queen Street.
Scottish Meteorological Society, 122 George Street.
Royal Scottish Society of Arts, 117 George Street.
Royal Society, The Mound, Princes Street.

Glasgow—
Archæological Society, 88 West Regent Street.
Baillie's Institution Free Library, Miller Street.
Faculty of Physicians and Surgeons of Glasgow, 242 St. Vincent Street.
Geological Society, 207 Bath Street.
Glasgow and West of Scotland Technical College Library, 38 Bath Street.
Institution of Engineers and Shipbuilders in Scotland, 207 Bath Street.
Mitchell Library, Miller Street.
Natural History Society of Glasgow, 207 Bath Street.
Stirling's Public Library, Miller Street.

Hamilton—
Mining Institute of Scotland.
Public Library.

Kelso—
Berwickshire Naturalists' Club. Rev. George Gunn, Stickhill Manse.

SWEDEN.

Upsala—
Royal University Library.

Stockholm—
Kongliga Svenska Vetenskaps-Akademie.

UNITED STATES.

Austin (Texas)—
Texas Academy of Science.

Baltimore—
John Hopkins University.

Boston—
American Academy of Arts and Sciences.
Boston Society of Natural History.

Colorado Springs—
Colorado Scientific Society.

Davenport (Iowa)—
Academy of Natural Sciences.

UNITED STATES—*continued.*

Des Moines (Iowa)—
Iowa Geological Survey.

Indianopolis (Ind.)—
Indiana Academy of Science.

Lawrence (Kansas)—
Kansas University Quarterly.

Madison—
Madison Geological and Natural History Society.
Washburn Observatory.

Newhaven (Conn.)
Connecticut Academy of Arts and Sciences.

New York—
American Geographical Society, 11 West Twenty-ninth Street.
American Museum of Natural History, Central Park, Seventy-seventh Street.
American Society of Civil Engineers, 220 West Fifty-seventh Street.
New York Academy of Sciences, Columbia University, West 116th Street.
School of Mines, Columbia College. The Associate Editor.

Philadelphia—
Academy of Natural Science of Philadelphia.
The Associated Alumni of the Central High School of Philadelphia.
American Pharmaceutical Association.
American Philosophical Society. The Hon. Secretaries, 104 South Fifth Street.
Franklin Institute, 15 South Seventh Street.
Numismatic and Antiquarian Society of Philadelphia.
Wagner Free Institute of Science, corner of Seventeenth Street and Montgomery Avenue.

Rochester (N.Y.)—
Rochester Academy of Science. Corresponding Secretary.

St. Louis—
Academy of Science of St. Louis.
Missouri Botanical Garden.

San Francisco (California)—
California Academy of Sciences.

Topeka (Kansas)—
Kansas Academy of Science.

Washington—
Bureau of Education (Department of the Interior).
Bureau of Ethnology.
Smithsonian Institution.
United States Geological Survey.
United States National Museum (Department of the Interior).
United States Naval Observatory.

LIST OF PERIODICALS.

(*Those received in exchange are indicated by an asterisk*).

WEEKLY.

Academy.
Architect.
Athenæum.
British Journal of Photography.
*British Refrigeration Review.
Builder.
Building News.
Chemical News.
Comptes Rendus.
*Deutsche Kolonialzeitung.
Dingler's Polytechnisches Journal.
Electrical Review.
Electrician.
*Engineering.
English Mechanic.
*Illustrated Official Journal of Patents.
*India-rubber and Gutta-percha and Electrical Trades Journal.
Journal of the Society of Arts.
*Journal of Gas Lighting.
*Lancet.
La Nature.
Nature.
Notes and Queries.
*Pharmaceutical Journal.
Scientific American and Supplement.

FORTNIGHTLY.

Annalen der Chemie (Liebig's).
*Berichte der Deutschen Chemischen Gesellschaft.
Journal für Praktische Chemie (Erdqmann's).
Zeitschritt für Angewandte Chemie.

MONTHLY.

*American Chemical Journal.
American Journal of Science.
Analyst.
Annalen der Physik und Chemie.
Annales de Chimie et de Physique.
Annales de l'Institut Pasteur.
Annales des Ponts et Chaussées.
Annales des Sciences Naturelles. Botanique.
Annales des Sciences Naturelles. Zoologie.
Annals and Magazines of Natural History.
Annales des Mines.
Antiquary.
Beiblätter zu den Annalen der Physik und Chemie.
Bulletin de la Société Chimique de Paris.
Bulletin de la Société Géologique de France.
Bulletin de la Société Industrielle de Mulhouse.
*Bulletin Mensuel de l'Observatoire de Montsouris.
*Canadian Entomologist.

MONTHLY—*continued.*

*Feilden's Magazine.
*Geographical Journal.
Geological Magazine.
*Johns Hopkins University Circulars.
Journal de Pharmacie et de Chimie.
Journal of Botany.
*Journal of the Chemical Society.
Journal of Education.
*Journal of the Franklin Institute.
*Journal of the Photographic Society.
*Journal of the Society of Chemical Industry.
*Journal de la Société Physico—Chimique Russe.
*Journal of the Western Society of Engineers.
London, Edinburgh, and Dublin Philosophical Magazine.
*Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
Petermanns Mitteilungen.
Polytechnic Bibliothek.
*Proceedings of Royal Society of London.
*Proceedings of the Society of Biblical Archæology.
Revue Universelle des Mines.
*Royal Astronomical Society's Monthly Notices.
Sanitary Journal.
Science Abstracts.
*Science of Man.
Science Gossip.
*Scottish Geographical Magazine.
*Travel.
Zoologist.

QUARTERLY.

Annals of Botany.
Annals of Scottish Natural History.
*Archives Néerlandaises des Sciences Exactes et Naturelles.
*Bulletin of the American Geographical Society.
Economic Journal.
Jahrbuch über die Forschritte der Mathematik.
Journal of Anatomy and Physiology.
*Journal of the Anthropological Institute of Great Britain.
*Journal of Manchester Geographical Society.
Journal of the Royal Agricultural Society of England.
*Journal of the Royal Institute of British Architects.
Journal of the Royal Microscopical Society.
*Journal of the Royal Statistical Society.
*Journal of the Scottish Meteorological Society.
*Kansas University Quarterly.
Mind: a Quarterly Review of Psychology and Philosophy.
*Proceedings of the American Philosophical Society.
Quarterly Journal of Economics.
*Quarterly Journal of Geological Society.
Quarterly Journal of Microscopical Science.
*Quarterly Journal of Royal Meteorological Society.
Quarterly Journal of Pure and Applied Mathematics.
Reliquary and Illustrated Archæologist.
Record of Technical and Secondary Education.
*School of Mines Quarterly.
*Sociedad Cientifica "Antonio Alzate."
*Transactions of the American Mathematical Society.
Zeitschrift für Analytische Chemie.

ANNUALLY.

Association Française pour l'Avancement des Sciences.
Cantor's Vorlesungen über Geschichte der Mathematik.
Hazell's Annual.
Jahres-Bericht Chemischen Technologie.
L'Année Scientifique et Industrielle.
Murray's English Dictionary.
Œuvres Complètes de Laplace.
Œuvres Complètes de Cauchy.
*Journal de L'Ecole Polytechnique.
Palæontographical Society's Publications.
Philosophical Transactions, Royal Society of London.
Ray Society's Publications.
Repertorium der Technischen Journal—Litterature.
Statesman's Year-Book.
Symons' British Rainfall.
Wright's English Dialect Dictionary.

The LIBRARY and READING-ROOM are open:—Winter, 9.30 a.m. till 8 p.m.; Meeting Nights till 10 p.m.; Saturdays, 2 p.m.
Summer (May till October), 9.30 a.m. till 5 p.m; Saturdays, 1 p.m.

LIST OF MEMBERS

OF THE

PHILOSOPHICAL SOCIETY OF GLASGOW

FOR 1900-1901.

HONORARY MEMBERS.

(*Limited to Twenty.*)

WITH YEAR OF ELECTION.

FOREIGN.

Rudolph Albert von Kölliker, Würtzburg. - - - - - - - - - - 1860
Professor Ernst Heinrich Hæckel, Jena. - - - - - - - - - - 1880
Professor Georg Quincke, Hauptstrasse 47, Friederischbaw, Heidelberg. - - 1890

AMERICAN AND COLONIAL.

Robert Lewis John Ellery, F.R.A.S., Victoria, Australia. - - - - - - 1874
Thomas Muir, M.A., LL.D., F.R.S.S., L. and E., Superintendent General of Education, Cape Colony. - - - - - - - - - - - - 1892
Professor S. P. Langley, LL.D., D.C.L., Secretary of the Smithsonian Institution, Washington, U.S.A. - - - - - - - - - - - - - 1895

BRITISH.

Sir Joseph Dalton Hooker, C.B., G.C.S.I., M.D., D.C.L., LL.D., F.R.S., The Camp, Sunningdale. - - - - - - - - - - - - - - - 1874
Herbert Spencer, care of Messrs. Williams & Norgate, 14 Henrietta Street, Covent garden, London. - - - - - - - - - - - - - 1879
Rev. John Kerr, LL.D., F.R.S., Glasgow. - - - - - - - - - - 1885
Sir George Gabriel Stokes, Bart., M.A., LL.D., D.C.L., F.R.S., Lucasian Prof. of Mathematics in the Univ. of Camb., Lensfield cottage, Cambridge. 1887
The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., F.R.A.S., F.R.S.G., Prof. of Nat. Philosophy in the Royal Institution, London, Terling place, Witham, Essex. - - - - - - - - - - - - - 1890
The Right Hon. Lord Lister, LL.D., D.C.L., P.R.S., 12 Park crescent, Portland place, London, W. - - - - - - - - - - - - - - 1895
Sir Archibald Geikie, LL.D., D.Sc., F.R.S., F.R.S.E., F.G.S., Director-General of the Geological Survey of the United Kingdom, 10 Chester terrace, Regent's Park, London, N.W. - - - - - - - - - 1895
The Right Hon. Lord Kelvin, G.C.V.O., LL.D., D.C.L., F.R.S., Largs. - 1896
(*Ordinary Member*, 1846 *till* 1896.)
James B. Russell, LL.D., M.D., 49 Braid road, Morningside, Edinburgh, *Honorary Vice-President*, - - - - - - - - - - - - - - 1899
Sir William T. Gairdner, K.C.B., M.D., LL.D., F.R.S., Edinburgh. - - - 1900

CORRESPONDING MEMBERS.

WITH YEAR OF ELECTION.

A. S. Herschel, M.A., D.C.L., F.R.S., F.R.A.S., Hon. Professor of Experimental Physics in the University of Durham; Observatory House, Slough, Bucks. - 1874
Thomas E. Thorpe, Ph.D., F.R.S., F.R.S.E., Principal of the Government Laboratories, Clement's Inn-passage, W.C. - - - - - - - - 1874
John Aitken, F.R.S., F.R.S.E., Ardenlea, Falkirk. - - - - - - - 1883
Alex. Buchan, M.A., LL.D., F.R.S.E., F.R.S., Secretary to the Scottish Meterological Society, 122 George street, Edinburgh. - - - - - - - 1883
James Dewar, M.A., F.R.S., F.R.S.E., M.R.I., Jacksonian Professor of Physics, University of Cambridge, and Professor of Chemistry in the Royal Institution of Great Britain, 1 Scroope terrace, Cambridge. - - - - - - - 1883
Stevenson Macadam, Ph.D., F.R.S.E., Prof. of Chemistry, Surgeons' Hall, Edinburgh. - - - - - - - - - - - - - - 1883
Joseph W. Swan, M.A., F.R.S., 58 Holland Park, W. - - - - - - 1883
William Milne, M.A., B.Sc., F.R.S.E., Department of Public Education, Cradock, Cape Colony. - - - - - - - - - - - - - 1894
Richard Lodge, M.A., Professor of History in Edinburgh University. - - - 1899

ORDINARY MEMBERS.

WITH YEAR OF ENTRY.

a Denotes Life Members.

Adam, Stephen, 199 Bath street. 1896
*a*Adam, Thomas, F.S.I., 27 Union street. 1892
Adams, John, M.A., B.Sc., Rector F.C. Training College, Glasgow, 12 Holyrood crescent. 1899
Adams, William, Makerstoun, Bearsden. 1891
Addison, W. H., Superintendent Deaf and Dumb Institution. 1895
*a*Agar, Thomas F., Argentine Consul-General, 7 Royal Bank place. 1896
Agnew, John, Viewfield, house, Carluke. 1901
Aikman, C. M.. M.A., D.Sc., F.R.S.E., F.I.C., F.C.S., 128 Wellington street. 1886
Aikman, W. G., 12 Kingsborough gardens, Kelvinside. 1899
Alexander, D. M., Marionville, Queen's drive. 1887
Alexander, G. W., M.A., 129 Bath street. 1893
Alexander, John, M.D., 3 Queen's crescent, W. 1900
Allen, Herbert Stanley, M.A., B.Sc., Blythswood laboratory, Renfrew. 1901
*a*Allan, Henry, 2 Park gardens. 1900
Allan, James W., M.B., 18 India street. 1900
Alston, J. Carfrae, 27 James Watt street. 1887
Anderson, Alexander, 157 Trongate. 1869
Anderson, David Blyth, 18 Park circus. 1897
Anderson, James, 4 Kingsborough gardens. 1900
Anderson, James, 168 George street. 1890
Anderson, John, 142 West Nile street. 1884
Anderson, J. B. Mackenzie, M.B., 42 Lansdowne crescent. 1895
Anderson, R. T. R., 80 Seedhill rd., Paisley. 1889
Anderson, Robert, 76 Bath street. 1896
Anderson, Robert, Eastwoodhill, Giffnock. 1900
*a*Anderson, Robert Locke, 233 St. Vincent street. 1901
*a*Anderson, T. M'Call, M.D., Professor of Practice of Medicine in the University of Glasgow, 2 Woodside terrace. 1873
Anderson, Wm., 12 Princes square. 1900
*a*Anderson, William, 284 Buchanan street. 1890
Anderson, W. F. G., 47 Union street. 1878
Andrew, Grant, 12 Woodside terrace. 1900
*a*Andrew, James, 160 West George street. 1900
Angus, Robter, Lugar, Ayrshire, N.B. 1901
*a*Annan, J. Craig, 234 Sauchiehall street. 1888

35 Annandale, Charles, M.A., LL.D., 35 Queen Mary avenue. 1888
Arneil, Allan, 13 Afton crescent. 1901
Arnot, James Craig, 162 St. Vincent street. 1869
*a*Arnot, J. L., 116 West Campbell street. 1890
Arrol, William A., Torwoodhill, Row. 1869
40*a*Arrol, Sir William, LL.D., Seafield, Ayr. 1900
Arthur, J., 78 Queen street. 1900
Arthur, Matthew, 78 Queen street. 1900
Arthur, Thomas G., Carrick house, Ayr. 1900

Bain, Andrew, 17 Athole gardens. 1890
45 Bain, Robert, 132 West Nile street. 1869
*a*Baird, J. G. A., M.P., Wellwood, Muirkirk. 1892
*a*Balfour, Alexander, Kelvindare, Kelvinside. 1900
Ballantine, George, jun., 100 Union street. 1897
Balloch, Robert, Eamont lodge, Dowanhill. 1843
50 Balmain, Thos., 1 Kew terrace, Kelvinside. 1881
Barbour, Wm., M.B., C.M., 5 Ashgrove terrace, Partickhill. 1900
Barclay, A. J. Gunion, M.A., F.R.S.E., High School. 1893
Barclay, A. P., 133 St. Vincent street. 1890
Barclay, George, 6 Colebrooke ter. 1891
55 Barclay, James, 16 Roxburgh street, Kelvinside. 1871
Barnet, John, 55 Oswald street. 1901
*a*Barr, Archibald, B.Sc., Professor of Civil Engineering and Mechanics in the University of Glasgow, Royston, Dowanhill, *Vice-President.* 1890
*a*Barr, James, C.E., I.M., F.S.I., 221 West George street. 1883
Barr, Thos., M.D., F.F.P.S.G., 13 Woodside place, W. 1879
60 Barrett, Francis Thornton, Mitchell Library. 1880
Bauermeister, F., 49 Gordon street. 1901
Baxter, John, I.M., 243 St. Vincent street. 1901
Baxter, W. R., 64 Gt. George street, Hillhead. 1900
Bayne, A. Malloch, 13 Kelvin drive, Kelvinside. 1878
65 Beardmore, W., Parkhead Forge. 1901
Beatson, George T., B.A. (Cantab.), M.D., 7 Woodside crescent. 1881
Becker, L., Ph.D., Professor of Astronomy in the University of Glasgow, The Observatory. 1859
Beckett, William, M.A., 225 West George street. 1900
Begg, Wm., 636 Springfield road. 1883
70 Beilby, George T., F.I.C., St. Kitts, Slateford. 1895
*a*Beith, Gilbert, 15 Belhaven terrace. 1881
Belhaven and Stenton, The Right Hon. Lord, Wishaw House, Wishaw. 1901
Bell, George, architect, 212 St. Vincent street. 1900
*a*Bell, Henry, Mynthurst, Reigate, Surrey. 1876
75 Bell, Sir James, Bart., 135 Buchanan street. 1877
*a*Bell, James T., Northcote, Dowanhill. 1896
*a*Bell, John J., Northcote, Dowanhill. 1896
*a*Bennett, Professor Peter, *Acting Secretary*, 207 Bath street. 1900
Bennett, Robert J., Alloway park, Ayr. 1883
80 Bergius, Walter, C.E., 77 Queen street. 1897
*a*Biggart, Thomas, 105 West George street. 1900
Bilsland, William, 28 Park circus. 1888
*a*Birkmyre, John, Broadstone, Port-Glasgow. 1900
*a*Bishop, A. Henderson, Burncroft, Thorntonhall. 1896
85 Black, J. Albert, Duneira, Row. 1869
Black, Malcolm, M.D., 5 Canning place. 1880
*a*Black, William Dunn, J.P., Auchentoshan, Dalmuir. 1901
*a*Blackie, J. Alexander, 17 Stanhope street. 1881
*a*Blackie, J. Robertson, 17 Stanhope street. 1881
90 Blackie, W. G., Ph.D., LL.D., F.R.G.S., 1 Belhaven terrace, Kelvinside. 1841
*a*Blackie, Walter W., B.Sc., 17 Stanhope street. 1886
Blackwood, Matthew, Ardmore, Port-Glasgow. 1901
Blair, G. M'Lellan, 2 Lilybank ter. 1869
Blair, J. M'Lellan, Williamcraig, Linlithgowshire. 1869
95 Blair, Matthew, 5 Hampton Court terrace. 1887
Blyth, Jas., M.A., LL.D., F.R.S.E., Professor of Natural Philosophy, Glasgow and West of Scotland Technical College, 204 George street. 1881
*a*Blyth, Robert, 1 Montgomerie quadrant. 1885
*a*Blythswood, The Rt. Hon. Lord, Renfrew, *President.* 1885

*a*Borland, William, 142 St. Vincent street. 1895
Borthwick, James D., 46 Balshagray avenue, Partick. 1891
Bottomley, James T., M.A., D.Sc., F.R.S., F.R.S.E., F.C.S., 13 University gardens, Hillhead. 1880
Bottomley, Wm., C.E., 15 University gardens. 1880
Bower, F.O., D.Sc., M.A., F.R.S., F.L.S., Regius Professor of Botany in the University of Glasgow, 1 St. John's terrace, Hillhead. 1885
*a*Boyne, James, 106 West Nile street. 1901
Boyd, John, Shettleston Iron-works, near Glasgow. 1873
*a*Broadfoot, William R., Inchholme Works, Whiteinch. 1900
Brodie, Wm. Brodie, M.B., C.M., Muirhead Demonstrator of Physiology, University of Glasgow. 1897
Bromhead, Horatio K., A.R.I.B.A., I.A., 243 St. Vincent st. 1901
Brown, Alex., The Craigs, Carmunnock. 1896
Brown, A. M., 22 West Nile street. 1900
Brown, George Arbuckle, M.B., C.M., D.P.H.(Camb.), 2 Oswald place, Whiteinch. 1900
*a*Brown, Hugh, 5 St. John's terrace, Hillhead. 1887
Brown, James, 76 St. Vincent street. 1876
*a*Brown, John, 11 Somerset place. 1881
Brown, John Armour, Moredun, Paisley. 1901
*a*Brown, Nicol Paton, 22 Belhaven terrace. 1901
Brown, Richard, Professor of Mercantile Law, St. Mungo's College, 166 St. Vincent street. 1895
Brown, Robert, 19 Jamaica street. 1882
Brown, Thomas Mathieson, coalmaster, Ardnith House, New Cumnock, Ayrshire. 1901
Brown, Wm., F.S.A.A., F.S.I., 138 West Regent street. 1901
*a*Brown, Wm. Stevenson, 67 Washington street. 1886
*a*Brown, William, 165 West George street. 1892
Browne, Robert, B.Sc., 45 Washington street. 1893
Brownlie, J. Rankin, L.D.S. (Eng.), 220 West George street. 1892
Bruce, Alex., Clyne House, Pollokshields. 1901
Bruce, David, M.A., LL.B., 141 West George street. 1897
Bryce, John, Assoc. M. Inst., C.E., 17 Peel street, Partick. 1900
Bryden, Robert A., F.R.I.G.A., F.S.I., 212 St. Vincent street. 1901
Buchan, David W., Fairy Knowe, Cambuslang. 1896
Buchanan, Alex. M., A.M., M.D., Professor of Anatomy, Anderson's College Medical School, 98 St. George's road. 1876
Buchanan, George S., 85 Candleriggs. 1845
Buchanan, Peter, 7 Garthland street. 1901
Buchanan, Rev. Robert, B.D., 28 Queen's crescent, Edinburgh. 1901
Buchanan, Robert Macneil, M.B., C.M., F.F.P.S.G., 9 Burnbank terrace. 1900
Buchanan, Walter, Clerkhill House, Dumbarton. 1901
*a*Buchanan, Wm., Enderley, Bearsden. 1886
Bulloch, John, Royal Exchange. 1900
Burnet, John James, A.R.S.A., F.R.I.B.A., 18 University avenue. 1892
Burns, Hon. G. A., 30 Jamaica street. 1900
Burns, J., M.D., 15 Fitzroy place, Sauchiehall street. 1864
Burton, Thomas John, M.D. (Ed.), Lonsdale, Bearsden. 1896
Burton, William L., 6 Richmond crescent, Glasgow. 1899
*a*Burrell, Wm., 54 George square. 1900

Caird, Robert, LL.D., F.R.S.E., 56 Esplanade, Greenock. 1898
Calder, William Ramsay, 102 Hope street. 1901
*a*Caldwell, George B., Scotia Leather Works, Boden street. 1892
Caldwell, James, 6 Newton place. 1900
Cameron, Sir Charles, Bart., M.P., M.D., LL.D., Greenock. 1870
Cameron, Sir Hector, M.D., Professor of Clinical Surgery, University of Glasgow, 200 Bath street. 1873
150*a*Campbell Arch., Springfield quay. 1895
*a*Campbell, J. A., LL.D., M.P., Stracathro, Brechin. 1848
Campbell, James Murdoch, 147 George street. 1901
Campbell, John, 49 St. Andrew's drive, Pollokshields. 1901
*a*Campbell, John Ferguson, 2 Holborn terrace, N. Kelvinside, *Vice-President.* 1892
Campbell, John M., F.E.I.S., Kennedy St. Public School, and 14 Royal crescent, Crosshill. 1900
Campbell, John MacNaught, C.E., F.Z.S., F.R.S.G.S, 5 Franklin terrace, Dumbarton road. 1883

Campbell, Malcolm, 18 Gordon street. 1894
*a*Campbell, Thomas, Maryhill Iron works. 1894
Cant, James, Woodholm, Bridge-of-Weir. 1901
160 Cargill, David S., 9 Park terrace. 1900
Carlile, William W., Hailie, Largs, Ayrshire. 1897
Carmichael, Neil, M.D., C.M., F.F.P.S.G., Invercarmel, 23 Nithsdale drive, Pollokshields. 1873
Carslaw, Horatio S., M.A., Assistant to the Professor of Mathematics, University of Glasgow. 1898
Carver, Thomas, A. B., B.Sc., C.E., 118 Napiershall street. 1890
165 Cassells, Robert Dunlop, B.Sc., 40 Nithsdale drive, Strathbungo. 1895
Cayzer, Herbert Robin, Ralston, Renfrewshire. 1901
*a*Cayzer, Sir Charles W., M.P., 109 Hope street. 1886
Chalmers, A. K., M.D., D.P.H. (Camb.), 7 Buckingham terrace. 1892
Chalmers, George, 13 Hamilton crescent, Partickhill. 1896
170 Chalmers, P. MacGregor, I.A., F.S.A., Scot., 95 Bath street. 1891
Chamen, W. A., Drumard, Partickhill road. 1898
Chisholm, James, 16 Knowe terrace, Pollokshields. 1899
Chisholm, John Oliver, surgeon, 16 Windsor terrace, St. George's road. 1900
*a*Chisholm, Samuel, LL.D., Lord Provost of Glasgow, 20 Belhaven terrace. 1890
175*a*Christie, Henry W., Levenfield House, Alexandria. 1892
Christie, John, Turkey-red Works, Alexandria, Dumbartonshire. 1868
*a*Christison, George, 13 Cambridge drive. 1897
Chrystal, W. J., F.I.C., F.C.S., Shawfield Works, Rutherglen. 1882
Clanachan, John, 4 Lloyd street, Dennistoun. 1900
180 Clark, John, Ph.D., F.I.C., F.C.S., 138 Bath street. 1870
Clark, John, 9 Wilton crescent. 1872
Clark, John, M.A., 2 Kersland st., Hillhead. 1897
*a*Clark, William, 125 Buchanan st. 1876
*a*Clarke, James Ferguson Wylie, M.A., F.R.C.S.Ed., 24 Buckingham terrace, Edinburgh. 1900
185 Cleland, James William, 1 Elm Court, Temple, London, E.C. 1901
*a*Cleland, John, M.D., LL.D., D.Sc., F.R.S., Professor of Anatomy in the University of Glasgow. 1884
*a*Coats, Archibald, Woodside, Paisley. 1900
Coats, John J., M.A., 27 Woodside place. 1900
*a*Cochran, Robert, 7 Crown circus, Dowanhill. 1877
190 Coghill, Wm. C., 263 Argyle street. 1873
Colquhoun, Walter, M.A., M.B., C.M., 7 Stanley street, W. 1900
Colville, James, M.A., D.Sc., 14 Newton place. 1885
Colvin, Thomas, M.B., C.M. 6 Royal terrace, Crosshill. 1900
*a*Combe, James Russell, 2 Royal crescent, Crosshill. 1895
195*a*Connell, Charles Broadfoot, Scotstoun Shipbuilding Yard, Whiteinch. 1900
*a*Connell, James G., 44 St. Enoch's square. 1900
Connell, Wm., Fairhill, Hamilton. 1870
Connell, William, jun., Coldstream, Cathkin road, Langside. 1897
Connor, George Muir, M.B., C.M., 574 Gallowgate. 1900
200 Cook, William, 77 St. Vincent street. 1900
Cooke-Taylor, R. W., West Lodge, Crown terrace. 1898
Copland, Wm. R., M.Inst.,C.E.,F.S.I., 146 West Regent street. 1876
Core, Wm., M.D., Barnhill Hospital. 1891
Cormack, J. D., B.Sc., Lecturer in Electrical Engineering, University of Glasgow. 1898
205 Costigane, John T., Limekilns House, East Kilbride. 1889
Costigane, William, Clifton hall, Albert drive, Pollokshields. 1890
Coubrough, A. Sykes, Parklea, Blanefield, Strathblane. 1869
Coulson, W. Arthur, 47 King street, Mile-end. 1888
Couper, James, Craigforth House, Stirling. 1862
210 Couper, Sinclair, Moore Park Works, Helen street, Govan. 1896
Cowan, M'Taggart, C.E., 53 Ashton terrace, Hillhead. 1876
Cowie, Archd., 196 St. Vincent street. 1900
Craig, T. A., C.A., 139 St. Vincent street. 1886
Cree, Thomas S., 21 Exchange square. 1869
215 Crichton, James, 201 Nithsdale road, Pollokshields. 1892
*a*Crookston, George B., 188 St. Vincent street. 1900
Cross, Alexander, M.P., 14 Woodlands terrace. 1887
*a*Cruikshank, Robert Alexander, J.P., shipowner, Ardbeg, Kilmun. 1901

*a*Crum, Walter G., Thornliebank. 1895
220 Crum, William G., Thornliebank. 1896
*a*Cullen, Alexander, F. R. S. E., F.R.I.B.A., Millburn, Dalserf, by Netherburn. 1901
*a*Curphey, Wm. Salvador, Borva, Lenzie. 1883
*a*Cuthbertson, Sir John N., LL.D., 29 Bath street. 1850
Cuthbertson, Thomas W., M.A., 25 Blythswood square. 1897

225 Darling, William, 178 St. Vincent street. 1901
*a*Daly, James, 2 Prince's gardens. 1898
Dalziel, J. Kennedy, M.B., C.M., 196 Bath street. 1896
Dansken, A. B., 105 West George street. 1877
*a*Dansken, John, I.M., F.S.I., F.R.A.S., 241 West George street. 1876
230 Dempster, John, 7 Knowe terrace, Pollokshields. 1875
Dennison, William, C.E., 175 Hope street. 1876
*a*Dick, George Handasyde, 136 Buchanan street. 1887
Dick, Thomas, 166 St. Vincent street. 1901
Dickie, John S., 31 St. Vincent place. 1900
235*a*Dixon, A. Dow, 10 Montgomerie crescent, Kelvinside. 1873
*a*Dixon, James S., Fairleigh, Bothwell. 1900
Dixon, Walter, 59 Bath street. 1893
Dobbie, A. B., M.A., 24 West Cumberland street. 1885
*a*Dobbie, Robert, Beechmount, Larbert. 1900
240 Docherty, P. Alpine, L.R.C.P., L.R.C.S.Edin., etc., 526 Springburn road. 1900
*a*Donald, James Addie, 12 Waterloo street. 1900
Donald, John, 23 Queen Margaret drive, N. Kelvinside. 1872
Donald, William, J. A., 16 Lilybank gardens. 1877
Dougall, Franc Gibb, 167 Canning street. 1875
245 Douglas, Campbell, I.A., F.R.I.B.A., 266 St. Vincent street. 1870
Downie, Robert, jun., Carntyne Dyeworks, Parkhead. 1872
Downie, Thomas, Hydepark Foundry. 1886
*a*Dreghorn, David, Smith st., Kinning Park. 1896
*a*Duncan, Eben., M.D., C.M., F.F.P.S.G., Queen's Park house, Langside road, *Hon. Vice-President.* 1873
250 Duncan, Hugh, M.A., LL.B., 27 University avenue. 1895
Duncan, J. A., Glenlee, Bridge of Allan. 1896
*a*Duncan, Robert, Whitefield Works, Govan. 1890
Dunlop, David John, Inch Works, Port-Glasgow, and 198 Bath street. 1900
Dunlop, John, F.E.I.S., headmaster, Parkhead Public School. 1900
255 Dunlop, John, M.D., 1 Somerset place. 1900
Dunlop, Matthew, 7 Clairmont gardens. 1901
*a*Dunlop, Nathaniel, 25 Bothwell st. 1870
Dunn, James E., 27 Union street, Glasgow, and Dunmullin, Strathblane. 1900
Dunn, Hugh Shaw, Earlston Villa, Caprington, Kilmarnock. 1901
260 Dunn, Robert Hunter, 4 Belmont crescent. 1878
Duthie, James, 129 St. Vincent street. 1901
Dyer, Henry, M.A., D.Sc., C.E., 8 Highburgh terrace, Dowanhill. 1883

*a*Edington, George Henry, M.D., M.R.C.S. (Eng.), F.F.P.S.G., 225 Bath street. 1896
Edmiston, John C., M.D., F.F.P.S.G., 6 Wilton gardens. 1901
265*a*Edwards, John, 4 Great Western terrace, west. 1883
Elgar, Francis, LL.D., F.R.S., 113 Cannon street, London, E.C. 1884
Elliot, G. F. Scott, M.A., B.Sc., F.L.S., F.R.G.S., Cedarhall, Kilmalcolm. 1896
Erskine, Jas., M.A., M.B., L.F.P.S.G., 351 Bath street. 1886
*a*Ewing, Wm., 45 Renfield street. 1883

270*a*Faill, John, 7 Winton drive, Kelvinside. 1901
Fairweather, Wallace, C.E., 62 St. Vincent street. 1880
Falconer, Patrick, 19 Kelvinside gardens. 1876
Falconer, Thos., 50 Kelvingrove st. 1880
Farrelly, John, 25 Elmbank crescent. 1901
275*a*Farquhar, Jas. T., 47 Hope street. 1901
Farquhar, John, 13 Belhaven ter. 1872
Farquhar, Wm. R., Marymar, Kilmalcolm. 1892
Fawsitt, Charles A., 9 Foremount terrace, Partick. 1879
*a*Fergus, Freeland, M.D., F.R.S.E., F.F.P.S.G., *Hon. Secy.*, 22 Blythswood sq. 1887

280 Fergus, James, 58 York street. 1901
*a*Fergus, Oswald, D.D.S., L.D.S., 12 Clairmont gardens. 1896
Ferguson, Alexr., 106 W. Regent street. 1901
Ferguson, David, Glenholm, Port-Glasgow. 1901
Ferguson, Fergus, 20 Royal terrace, West. 1900
285 Ferguson, James, 18 Leven street, Pollokshields. 1897
*a*Ferguson, John, M.A., LL.D., F.R.S.E., Professor of Chemistry, University of Glasgow, *Hon. Vice-President.* 1869
Ferguson, John Forbes, 166 St. Vincent street. 1895
Fergusson, Alex. A., 48 M'Alpine st. 1847
Fife, William, jr., Fairlie, Ayrshire. 1901
290 Findlay, Joseph, Clairmont, Winton drive, Kelvinside. 1873
Finlayson, James, M.D., 2 Woodside place. 1873
Fleming, Dr. Robert H., 19 Newton street, Charing cross. 1901
*a*Fleming, E. Brown, Mambeg, Dumbartonshire. 1900
*a*Fleming, James, 136 Glebe street. 1880
295 Fleming, James H., L.R.C.S.E., L.R.C.P.E., L.F.P.S.G., 338 Duke street, Dennistoun. 1900
*a*Fleming, John, 241 St. Vincent st. 1900
Flower, Collingwood, the Hermitage, Drumchapel. 1901
*a*Forrester, Henry, 45 West Nile street. 1900
Forrester, Robert, 142 West Nile street. 1901
300 Foster, W. A., St. Catherines, Newlands road, Langside. 1899
Fotheringham, T. B., 52 Barrland street, Maxwell road. 1889
Foulis, William, C.E., 45 John st. 1870
*a*Fowler, John, 2 Grantley gardens, Shawlands. 1880
Frame, James, 45 Keir street, Pollokshields. 1885
305 Fraser, James, 53 Queen Mary avenue, Crosshill. 1901
Fraser, Melville, 31 St. Vincent place. 1890
Fraser, Thomas Smellie, F.S.I., 209 St Vincent street. 1900
Fraser, Wm., F.S.I., 209 St. Vincent street. 1900
Freebairn, J. B., M.A., Napiershall Public School. 1900
10*a*French, Thomas, 1 Kelvinside ter. 1897
Frew, Alex. C.E., Assoc. M. Inst. C.E., 140 West George street 1876
*a*Frew, William, Ph.D., Wellpark Brewery. 1898
Fryers, Arthur John, 22 Bath street, Largs. 1899
*a*Fullerton, Robt., M.D., 24 Newton place. 1896
315 Fulton, James, The Glen, Paisley. 1897
Fulton, R. C., 14 Hamilton Park terrace. 1890
Fyfe, Alexander, 38 Burnbank gardens. 1897
Fyfe, A. Peden, 135 St. Vincent street. 1900
Fyfe, Henry B., 115 St. Vincent st. 1892
320 Fyfe, Leander M., F.E.I.S., Queen's Park School, Glasgow. 1899

*a*Gairdner, C. D., C.A., 115 St. Vincent street. 1886
Galbraith, Peter, 122 Wellington st. 1889
Galbraith, Walter M., 7 Holyrood crescent. 1893
Gale, James M., C.E., 45 John st. 1856
325 Galloway, T. Lindsay, C.E., 43 Mair street, Plantation. 1881
Galt, Professor Hugh, M.B., C.M., F.F.P.S.G., D.P.H.(Camb.), 14 Berkeley terrace, W. 1900
Gardiner, John, 18 Gibson street, Hillhead. 1901
Gardner, Daniel, 36 Jamaica street. 1869
Gardner, John, 146 Trongate. 1901
330 Gardner, John R., 33 Huntly gardens, Kelvinside. 1900
*a*Garrett, Geo., Dunbeth lodge, Coatbridge. 1901
*a*Garrow, James R., 6 Pollok road. 1890
*a*Garroway, John, 694 Duke st. 1875
Gibson, Charles R., Lynton, Hawkhead, Paisley. 1895
335 Gibson, William, 2 Wilton mansions. 1896
Gilfillan, Robert, Springbank Public School, Hinshaw street. 1900
Gilfillan, Wm., 129 St. Vincent st. 1881
*a*Gillies, William, Shawlands house. 1901
Gillies, W. D., 17 Royal Exchange square. 1872
340 Glaister, John, M.D., F.F.P.S.G., D.P.H.(Camb.), F.R.S.E., F.C.S., &c., Professor of Forensic Medicine and Public Health, University of Glasgow, 18 Woodside place. 1879
*a*Glaister, Joseph Newbigging, M.B., C.M., 5 Ronald street. 1900
*a*Glen, Lawrence, 165 St. Vincent street. 1900
*a*Glen, Robert, Carlston, Kelvinside. 1901
Goldie, James, 52 St. Enoch square. 1883
345 Goodwin, Robert, 58 Renfield street. 1875
*a*Gordon, James, Stonebyres, 14 Aytoun road, Pollokshields. 1901
Gordon, John, M.D., C.M., 3 Rosebery terrace, Kelvinbridge. 1900

*a*Gourlay, Charles, B.Sc., A.R.I.B.A., Professor of Architecture, Glasgow Technical College, 30 Hamilton drive, Hillhead, 1900
Gow, J. R., 12 Renfield street. 1898
350 Gow, Leonard, 45 Renfield street. 1889
Gow, Leonard, jun., 45 Renfield st. 1884
Gow, Robert, 3 Victoria circus, Dowanhill gardens. 1860
Graham, John Hatt Noble, Larbert House, Stirlingshire. 1900
*a*Graham, Robert, 108 Eglinton st. 1888
355*a*Graham, William, B.L., 11 Claremont terrace. 1885
*a*Graham, William, C.A., 6 Royal crescent, W. 1900
Graham, Wm. Edward Auld, 7 Royal Bank place. 1900
Graves, John William, Hydropathic, Kilmalcolm. 1901
Gray, Andrew, 30 Bath street. 1889
360 Gray, Andrew, LL.D., F.R.S., Professor of Natural Philosophy in Glasgow University. 1899
Gray, James, M.D., 15 Newton terrace. 1863
Gray, John, 181 Renfrew street. 1901
Green, George, J.P., 40 Balshagray avenue, Partick. 1900
Greer, Thomas Arthur, Fairfield works, Govan. 1901
365 Greig, James R., Claremont, Langside. 1897
Grier, R. P., 54 Newark drive, Pollokshields. 1901
Gumprecht, John, 4 West Regent street. 1900
Gunn, N. B., 35 St. Vincent place. 1900
Guthrie, David William, 9 Jane street, Blythswood square. 1900
370 Guthrie, John, 17 Whittinghame drive, Kelvinside. 1901

Halket, George, M.D., F.F.P.S.G., 4 Royal crescent, W. 1889
Hall, Peter Wishart, Kyle street, Dobbie's loan. 1901
*a*Hamilton, John, I.A., 212 St. Vincent street. 1885
Hamilton, Robert O., Victoria Grain Mills, West street, Kingston. 1898
375 Hanbidge, James E., 8 Balmoral crescent, Crosshill. 1897
Hannay, P. M., Bridge of Allan. 1898
*a*Harrington, J. P., Broadfield, Port-Glasgow. 1900
Harington-Stuart, P. E. S. (Colonel), Torrance, East Kilbride, N.B. 1900
Harris, F. W., 81 Gower street, Kelvinside, N. 1900
380 Harrison, John, J.P., 7 Granby terrace. 1900
Harvey, William Ure, Ornsay, Glenburn road, Bearsden. 1896
Harvie, William, 8 Bothwell terrace, Hillhead. 1888
Hassard, William John, 209 Sauchiehall street. 1895
Hedderwick, Maxwell, 22 St. Vincent place. 1892
385*a*Henderson, A. P., 20 Newton place. 1880
Henderson, Francis, 47 Union street. 1901
Henderson, George G., M.A., D.Sc., F.I.C., F.C.S., Professor of Chemistry, Glasgow and West of Scotland Technical College, 204 George street. 1883
Henderson, John, Towerville, Helensburgh. 1890
*a*Henderson, Thomas, 1 Lancaster crescent, Kelvinside. 1900
390 Henderson, Thomas Beath, M.D., 155 Bath street, Glasgow. 1899
*a*Henderson, William, 15 Cadogan st. 1873
Hendry, Geo. Scott, 87 Bothwell st. 1895
Henry, R. W., 9 Parkgrove ter., W. 1875
Heys, Zechariah J., South Arthurlie, Barrhead. 1870
395 Higgins, Henry, jun., 248 West George street. 1878
Hinshelwood, James, M.A., M.D., 9 Elmbank street. 1896
Hodge, James R., C.A., 105 West George street. 1900
Hodge, William, 27 Montgomerie drive, Kelvinside. 1878
Hogg, Robert, 9 Nithsdale drive, Pollokshields. 1865
400 Holmes, Daniel T., B.A., Woodburn, Kilmalcolm. 1898
Honeyman, P. S., 12 South Park terrace. 1900
Hood, Archibald J., M.A., 2 Kelvingrove terrace, 1901
*a*Hope, James, Dean house, Lenzie. 1898
Horne, Joseph, M.B., C.M., 5 Windsor street. 1900
405 Houldsworth, J. H., Rozelle, Ayr. 1900
*a*Houldsworth, Wm. Thos., Clerk in Holy Orders, 1 Mansfield street, Portland place, London, W. 1901
Houstoun, Wm. Henry, Hillcrest, Cambridge drive. 1895
Howat, William, 37 Elliot street. 1885
Hunt, Edmund, 121 W. George st. 1856
410*a*Hunt, John, Milton of Campsie. 1881
Hunter, James, 89 Mitchell street. 1900
Hunter, Richard H., Glentyan, Kilbarchan, Renfrewshire. 1900
Hunter, Robert, 72 Waterloo street. 1901

Hunter, the Rev. John, D.D., 9 University gardens, Glasgow. 1899
415 Hunter, Walter K., M.D., 1 Newton terrace, Glasgow. 1899
*a*Hunter, Wm. S., 70 Robertson st. 1889
Hutchison, John C., 8 Lansdowne crescent. 1900
Hutchison, Joseph, Woodside, Netherburn, Lanarkshire. 1901
Hutton, James, C.A., 203 West George street. 1897
420 Hutton, W. K., M.A., M.B, Senior Demonstrator of Anatomy, The University. 1900
*a*Hyslop, William, of Bank, New Cumnock. 1901

Inglis, John, LL.D., Pointhouse Shipyard. 1895
*a*Inglis, Malcolm, 48 St. Andrew's square. 1900
Inglis, R. A., Culrain, Bothwell, 1809
425 Innes, Gilbert, 27 Hamilton drive, Hillhead. 1900

Jack, William Robert, M.D., 43 Lansdowne crescent. 1899
*a*Jack, William, M.A., LL.D., Professor of Mathematics in the University of Glasgow. 1881
Jackson, Thomas, C.A., 24 George square. 1900
Jamieson, Andrew, F.R.S.E., M.Inst.C.E., M.Inst.E.E., etc., 16 Rosslyn terrace, Kelvinside. 1881
430 Jenkins, James Graham, Airedale, Cambuslang. 1901
Jenkins, Thomas, Woodlands, Crosshill. 1901
Johnston, Alex., M.D. (Glasgow), D.P.H. (Camb)., Ruchill Hospital. 1900
Johnston, David, 160 West George st. 1891
Johnston, George, Mosesfield, Springburn. 1896
435 Johnston, William G., 18 Coatbridge street, Port Dundas. 1901
Johnstone, Jas., Coatbridge street, Port-Dundas. 1869

Kay, Cathcart, 77 St. Vincent street. 1900
Kay, Thomas, M.B., C.M., 5 Rosebery street. 1899
Kean, James, 32 Scotia street, Garnethill. 1888
440*a*Kelly, Alexander, 100 Hyde Park street. 1901
Kelly, Hugh, M.D., Catrine Bank, Shields road, Pollokshields. 1898
Kelly, J. H., J.P., Parkhead. 1900
Kelly, James K., M.D., F.F.P.S.G., Park villa, Queen Mary avenue, Crosshill. 1889
Kelly, John Davidson, M.A., Stanley house, Bridge-of-Allan. 1901
445 Kemp, Wm. (Alexander, Fergusson, & Co., Ltd.), Ruchill, Maryhill. 1898
Kennedy, James, 33 Greendyke st. 1889
*a*Kennedy, Moses Hunter, 217 West George street. 1901
*a*Kennedy, William, Partick, 13 Victoria crescent, Dowanhill. 1900
*a*Ker, Charles, M.A., C.A., 155 St. Vincent street. 1885
450*a*Ker, Wm., 1 Windsor ter., West. 1874
Kerr, Adam, 175 Trongate. 1887
Kerr, Geo. Munro, 97 Buchanan st. 1890
Kerr, John G., M.A., LL.D., 15 India street. 1878
Key, William, 109 Hope street. 1877
455 Kidston, Geo. J., Finlaystone, Langbank. 1900
*a*Kidston, William H., 81 Great Clyde street. 1900
Kiep, Johannes N., Imperial German Consul, 128 St. Vincent street. 1900
*a*King, Chas. M., Antermony house, Milton of Campsie. 1900
King, Sir James, Bart., LL.D., of Campsie, 115 Wellington street. 1855
460 King, John, Tigh Ruach, Possilpark. 1895
King, John C., 21 Newton place. 1898
Kirk, Robert, M.D., Newton cottage, Partick. 1877
Kirkpatrick, Alexander B., 88 St. Vincent street. 1885
Kirkwood, James, Carling lodge, Ibrox. 1890
465 Knight, James, M.A., B.Sc., F.C.S., F.G.S., F.E.I.S., The Shieling, Uddingston. 1893
Knight, John, M.B., C.M., D.P.H., 2 Clydeford drive, Tollcross. 1900
*a*Knox, David J., 19 Renfield street. 1890
Knox, John, Finnieston School. 1900

Laird, John, Marchmont, Port-Glasgow. 1876
470 Laird, John, Royal Exchange Sale Rooms. 1879
Lamb, David, 155 Hyndland road, W. 1896
Lamberton, Alex., 8 Adelphi terrace. 1900
Lamberton, Hugh, Lylestone, Pollokshields. 1901
*a*Lamberton, Hugh, John Gray & Co., Ltd., Adelphi terrace. 1900
475 Lambie, Robert, Strathview, Larkhall. 1901

Lamond, Robert, M.A., LL.B., 163 West George street. 1894
Lamont, Alexander, Kelvinbaugh Public School, 10 Ardgowan terrace, Sandyford. 1900
Lang, William, F.C.S., Crosspark, Partick. 1865
Lang, W. R., D.Sc., Professor of Chemistry in the University of Toronto, Canada. 1899
480 Large, John, Norwich Union Chambers, St. Vincent street. 1901
Laughland, David, 11 Newton terrace. 1901
*a*Lauder, James, F.R.S.L., Glasgow Athenæum. 1892
*a*Lauder, John, 46 Gordon street. 1894
Law, James H., Brandon House, Ibrox. 1901
485 Law, John, R. K., 20 Ashton gardens, Dowanhill. 1896
*a*Lawson, Thomas, Birchgrove, Polkshields. 1901
Lee, William, M.A., F.E.I.S., teacher, 298 Cumbernauld road. 1901
*a*Lindsay, Archd. M., M.A., 87 West Regent street. 1872
Lindsay, John, City Chambers. 1897
490 Lindsay, William A., M.A., B.Sc., Lecturer, F.C. Training College, Glasgow, 4 Lloyd street, Dennistoun. 1900
Long, William A. R. Jex, Larch Hill, Moffat. 1898
Lothian, Alex. V., M.A., 11 Holborn terrace. 1891
Love, James Kerr, M.D., C.M., 10 Newark drive. 1888
Love, William, 28 Royal Exchange square. 1901
495 Low, Isaac, 60 Weaver street. 1898
Lumsden, Harry, M.A., LL.B., 105 West George street. 1900
Lundholm, C. O., Nobel's Explosives Factory, Ardeer, Stevenston. 1890

MacAndrew, Francis Glen, of Knock, Knock Castle, Largs. 1901
M'Ara, Alexander, 65 Morrison street. 1888
500 Macara, James, 19 Waterloo street. 1901
Macara, Mudie, 1 Belmont street. 1901
M'Arly, Thomas, 29 West George street. 1897
MacArthur, J. G., Rosemary villa, Bowling. 1874
*a*M'Arthur, John S., 45 Renfield street. 1890
505 Macaulay, C. E. (Colonel), 2 Cathedral square. 1901
M'Bryde, Peter, M.B., 18 Queen's crescent, W. 1900
M'Callum, Robert, jun., 69 Union street. 1891
*a*M'Clelland, Andrew Simpson, C.A., 4 Crown gardens, Dowanhill. 1884
M'Conville, John, M.D., 27 Newton place. 1870
510 M'Cosh, Andrew K., Cairnhill, Airdrie. 1901
*a*M'Cowan, David, jun., 6 Eton gardens, 1898
M'Cracken, James, 5 Bowmont terrace, Kelvinside. 1889
M'Crae, John, 7 Kirklee gardens, Kelvinside. 1876
M'Creath, James, M.E., 208 St. Vincent street. 1874
515 M'Culloch, Hugh, 154 West Regent street. 1880
M'Donald, Alexander, M.A., 14 Carmichael place, Langside. 1900
M'Donald, Alexander Beith, M.Inst. C.E., city engineer, City Chambers. 1901
*a*M'Donald, David, 34 Huntly gardens, Kelvinside. 1897
*a*M'Donald, John, 72 Great Clyde street. 1896
520 Macdonald, John King, J.P., 4 Hillend gardens, Partickhill. 1900
M'Dougall, Daniel Douglas, 2 Kingsborough gardens, Kelvinside. 1899
*a*Macdougall, Robert, F.S.A.A., F.S.I., 138 West Regent street. 1900
M'Elligott, John, 4 Victoria drive, Mount Florida. 1901
*a*M'Ewen, Robert, 11 Park terrace. 1900
525*a*Macfarlane, Walter, 22 Park circus. 1885
M'Farlane, Wm., Edna Lodge, Ruthergien. 1888
*a*M'Gilvray, R. A., 129 West Regent street. 1880
M'Gregor, A. N., M.D., 121 Douglas street. 1900
*a*Macgregor, R. D., 137 West George street. 1900
530 Machell, Thomas, 1 Burnbank ter. 1886
M'Houl, David, Ph.D., Dalquhurn, Works, Renton. 1883
*a*Macindoe, Alex., 104 West George street. 1894
Macintyre, John, M.B., C.M., 179 Bath street. 1895
*a*M'Intyre, T. W., 21 Bothwell street. 1900
535 M'Intyre, Wm., F.E.I.S., Appin, Melrose Avenue, Rutherglen. 1888
M'Kail, David, M.B., Ch.B., 483 London road. 1901

*a*M'Kechnie, D., 14 Candleriggs. 1900
M'Kellar, John C., 112 Bath street. 1896
M'Kellar, J., 25 Kelvinside terrace. 1893
540*a*M'Kendrick, John G., M.D., C.M., LL.D., F.R.S., F.R.S.E., F.R.C.P.E., Professor of Physiology in the University of Glasgow, 2 Buckingham terrace, *Hon. Vice-President*. 1877
M'Kendrick, J., Souttar, M.D., F.R.S.E., 2 Buckingham terrace. 1900
Mackenzie, John Alexander, M.B., C.M., 4 Carmichael place, Langside. 1900
Mackenzie, Thomas Riach, 16 Robertson street. 1901
*a*M'Kenzie, W. D., 43 Howard street. 1875
545 M'Kie, John, M.B., C.M., Florence bank, Springburn. 1899
*a*Mackinlay, James Murray, 4 Westbourne gardens. 1886
*a*Mackinlay, J. T. C., 210 Nithsdale road, Pollokshields. 1900
*a*Mackinlay, R. W., 52 Aytoun road, Pollokshields. 1900
Mackintosh, Donald J., M.B., C.M., Western Infirmary, 1894
550 Maclae, A. Crum, 147 St. Vincent street. 1884
Maclaren, Norman H. W., demonstrator, Zoological Laboratory, University. 1900
M'Laren, Robert, Royal Bank, Garscube cross. 1898
M'Laren, William, 7 Westbank quadrant, Hillhead. 1899
MacLachlan, Dugald, B.L., 28 Renfield street. 1901
555 MacLaurin, Robert, 39 Caldercuilt road 1895
M'Lay, James, C.A., 94 Hope street. 1900
MacLay, Professor Alex., B.Sc., C.E., Camptower, Bearsden. 1901
Maclay, W., Thornwood, Langside. 1893
M'Lean, Angus, B.Sc., C.E., Principal, Technical School, Paisley. 1897
560 Maclean, A. B., Craigpark Works, Dennistoun. 1899
M'Lean, Charles R., L.R.C.P.E., L.R.P.S.G., 15 Annfield place, Dennistoun. 1900
Maclean, Magnus, M.A., F.R.S.E., D.Sc., Professor of Electrical Engineering, Glasgow and West of Scotland Technical College, 51 Kersland terrace, Hillhead. 1885
*a*MacLehose, James J., M.A., 61 St. Vincent street. 1882
*a*Macleod, A., 3 Dundas street. 1893
565 Macleod, the Rev. Donald, B.A., D.D., 1 Woodlands terrace, 1900
MacLellan, Lewis, 5 Bowmont gard. 1899
*a*Maclellan, Peter, Glasgow Rubber Works, Maryhill. 1900
*a*Maclellan, Wm. Walter, 3 Montague terrace, Kelvinside. 1900
M'Michael, Thomas, M.A., 54 Windsor street. 1901
570 M'Millan, A. Lewis, M.D., C.M., 1 Rosebery terrace, Gt. Western road. 1897
M'Millan, Archibald, Invermay, Balshagray, Partick. 1899
M'Millan, Robert, Methlan park, Dumbarton. 1901
*a*Macnab, James, Lilyburn, Milton of Campsie, Stirlingshire. 1901
Macnair, Andrew Duncan, Benvue, Dowanhill gardens. 1901
575 Macnair, John, 130 Claythorn street, and 1 Morris place, Monteith row. 1900
Macnair, Matthew, 1 Morris place, Monteith row. 1901
M'Nish, Robert, 14 Carrick street. 1901
Maconechy, Robert, Regent Park, Prestwick, Ayrshire. 1900
Macphail, Donald, M.D., Garturk cottage, Whifflet, Coatbridge. 1877
580 Macpherson, Duncan, Rosemount School. 1900
M'Vail, D. C., M.B., Professor of Clinical Medicine, St. Mungo's College, 3 St. James' terrace, Hillhead. 1873
Macwhannell, Ninian, 58 West Regent street. 1898
Main, Robert B., 56 Dalziel drive. 1885
Malloch, A. M., Firhill, Garscube road. 1896
585*a*Mann, James, 4 University gardens. 1900
Mann, John, C.A., 137 West George street, *Hon. Treasurer*. 1856
Mann, John, jun., M.A., C.A., 9 Woodlands terrace, W. 1885
Mann, Ludovic MacLellan, 137 West George street. 1897
*a*Mann, Robert M., 3 Montgomerie crescent. 1900
590 Manwell, James, The Hut, 4 Albert drive, Pollokshields. 1876
Marks, Samuel, 145 Great Eastern road. 1884
Marr, John, J.P., Dunjarg, Bellahouston, Govan. 1900
Marr, Hamilton Clelland, M.D., Woodilee Asylum, Lenzie. 1899
Marshall, James, Woodcroft, Crow road, Partick. 1900
595*a*Marshall, Robt., 97 Wellington street. 1900

Marshall, T. Rhymer, D.Sc., Professor of Chemistry in St. Mungo's College, 19 Sandyford place. 1894
Martin, Jas. F., 63 Brunswick st. 1895
Martin, John, writer, 58 West Regent street. 1901
Martin, Robert, 8 Burnbank terrace, W. 1897
600 Marwick, Sir J. D., LL.D., F.R.S.E., 19 Woodside terrace. 1878
Mathie, George M., 15 Dunard road, Rutherglen. 1895
Mathieson, J. H., 3 Grosvenor ter., Kelvinside. 1896
Mathieson, T. O., 3 Grosvenor ter. 1896
Mavor, Henry A., 47 King street, Mile-end. 1887
605 Mavor, Samuel, 37 Burnbank gard. 1890
Maxton, J., 27 Cedars road, Clapham common, London, S.W. 1900
May, A. H., 1 Crown circus, Dowanhill. 1898
Mayer, John, Strathview, Cathkin road, Langside. 1860
Mechan, Arthur, 60 Elliot street. 1876
610 Mechan, Henry, 60 Elliot street. 1879
Melville, George, 14 Princes square. 1901
Menzies, Thos., Hutchesons' Grammar School, Crown street. 1859
Menzies, William Crawford, City Improvement Trust, 34 Trongate. 1895
Metcalfe, John Ramsay, 19 Montgomery quadrant. 1901
615 Millar James, 158 Parliamentary rd. 1870
Miller, Alexander Wingate, 79 West Nile street. 1900
Miller Alexander, jun., Broomhill, Partick. 1899
Miller, A. Lindsay, 122 Wellington street. 1878
*a*Miller, Arch. Russell, Castlebank, Bothwell. 1884
620 Miller, James, 5 Hanover street. 1900
Miller, Major, David S., 8 Royal crescent, W. 1887
*a*Miller, George, Winton drive, Kelvinside. 1881
Miller, G. J., Frankfield, Shettleston. 1888
*a*Miller, J. C., 40 West Nile street. 1900
625 Miller, John, M.D., 323 Springburn road. 1900
*a*Miller, Thos. P., Cambuslang Dyeworks. 1864
Mills, Edmund J., D.Sc., LL.D., F.R.S., Emeritus Professor of Technical Chemistry, Glasgow and West of Scotland Technical College, 11 Greenhill road, Harrow. 1875
Mirrlees, James B., Redlands, Kelvinside. 1866
*a*Mirrlees, William J., 45 Scotland st. 1889
630 Mitchell, Alexander Brown, Avon Bank house, Larkhall. 1901
Mitchell, Andrew, C.A., The Glasgow District Subway Co., St. Enoch square Station. 1896
*a*Mitchell, George A., F.R.S.E., 5 West Regent street. 1883
Mitchell, Nelson, 3 Great Western terrace. 1898
Mitchell, Wm. James, M.A., B.L., 49 West George street. 1897
635 Mitchell, J. O., LL.D, 7 Huntly gardens. 1899
*a*Moffatt, Alexander, 23 Abercromby place, Edinburgh. 1874
Mollison, James, 6 Hillside gardens, Partick. 1889
*a*Mond, Robert Ludwig, B.A. (Cantab.), F.R.S.E., 20 Avenue road, Regent's park, London, N.W. 1890
*a*Monro, T. K., M.A., M.D., F.F.P.S.G., 10 Clairmont gards. 1897
640*a*Monteith, Robert, Greenbank, Dowanhill gardens. 1885
Moore, Alexander, C.A., 50 Montgomerie drive, Kelvinside. 1869
Moore, Alexander George, M.A., B.Sc., 13 Clairmont gardens. 1886
Morrice, Jas. A., 1 Prince's ter., Dowanhill. 1883
Motion, James Russell, 38 Cochrane street. 1887
645 Motion, Thomas Mason, 6 Melrose street, Great Western road. 1897
Muir, Alex., 400 Eglinton street. 1883
*a*Muir, Allan, Ardmay, Newlands road, Langside. 1881
Muir, Matthew Greenlees, 12 Waterloo street. 1901
Muir, Sir John, Bart., 22 West Nile street. 1876
650 Muir, Robert, M.D., F.R.C.P.E., Professor of Pathology in Glasgow University, 4 Alfred terrace, Hillhead. 1899
*a*Muirhead, Andrew Erskine, Cart Forge, Crossmyloof. 1873
Muirhead, James, 2 Bowmont gardens, Kelvinside. 1887
*a*Muirhead, Robert F., M.A., B.Sc., 24 Kersland street, Hillhead. 1879
Munro, Alexander, M.B., C.M., 569 Gallowgate. 1900
655 Munro, Daniel, F.S.I., 10 Doune terrace, Kelvinside. 1867
Munro, Donald Mackay, 88 St. Vincent street. 1901
Munro, J. M. M., M.Inst. E.E., M.Inst.C.E., F.R.S.E., 136 Bothwell street. 1896

Munsie, George, 109 Virginia place. 1871
Munsie, Robert George, 109 Virginia place. 1883
660 Murdoch, George, 40 St. Vincent place. 1894
Murdoch, John, writer, 208 West George street. 1901
*a*Murdoch, Robert, 91 Maxwell road. 1880
*a*Murray, Daniel, 5 Wilton crescent. 1896
*a*Murray, David, LL.D., 169 West George street. 1876
665 Murray, John Bruce, 24 George square. 1890

Napier, Alex., M.D., F.F.P.S.G., Rose Bank, Queen Mary avenue, Crosshill. 1886
Napier, James, M.A., F.R.S.E., The Drums, Old Kilpatrick. 1900
Napier, Robert T., 75 Bothwell street, Glasgow. 1899
Neilson, Archibald Garibaldi, 11 Bothwell street, 1901
670*a*Neilson, George, 34 Granby ter. 1897
*a*Neilson, James, 116 Bishop street, Port-Dundas. 1896
*a*Neilson, John, Mollance, Castle-Douglas. 1900
*a*Neilson, Walter, Ewenfield, Ayr. 1900
Neilson, William, 27 Robertson street, Greenock, 1899
675 Nelson, Alex., 80 Gordon street. 1880
*a*Nelson, John E., 26 Queen street. 1900
Nelson, Thos. C., Craiglea, Dennistoun. 1900
*a*Newlands, Joseph F., 28 Renfield street. 1883
Nicol, James Monro, 93 Cheapside street. 1901
680 Nicoll, James H., M.B., 4 Woodside place. 1897
Nish, Robert, 9 Claremont terrace. 1897

Orr, John, 107 Wellington street. 1901
Orr, Robert, 79 West Nile street. 1890
*a*Osborne, Hugh, 4 Kew terrace, Glasgow. 1899
685 Osborne, Robert, 4 Huntly gardens. 1890

Palgrave, A. G., 17 Wilton mansions, Kelvinside, N. 1900
Park, James, 51 Milburn street. 1877
*a*Park, Lieut.-Colonel James Smith, V.D., 61 Hamilton drive. 1900
Park, Robert, M.D., 40 Grant st. 1894
690 Parker, Edward H., 11 Strathmore gardens, Hillhead. 1897
*a*Parker John Dunlop, C.E., 146 West Regent street. 1889
Parker, James H., B.L., C.A., 89 West Regent street. 1900
*a*Parnie, William, 27 Union street. 1897
Parry, Robert Henry, F.R.C.S.E., 3 Royal crescent, Queen's Park. 1900
695*a*Paterson, Robert, C.A., 28 Renfield street. 1881
Paton, James, F.L.S., Corporation Galleries and Kelvingrove Museum. 1876
Patrick, Joseph, M.A., C.A., 203 West George street. 1893
Patrick, Joseph, of Alex. Kay & Co., Royal Exchange buildings. 1900
Patterson, T. L., F.C.S., Maybank, Finnart street, Greenock. 1873
700 Peacock, T. Reid, 122 Wellington street. 1898
Peck, James W., M.A., Arnott Demonstrator in Natural Philosophy, Glasgow University, Newington, South Brae drive. 1899
Petrie, Alexander, I.A., 134 Wellington street. 1885
Petrie, John W., 83 Oxford drive. 1900
Pinkerton, John, M.D., Q.H.P., Surgeon-General, Queen's Park House, Langside. 1900
705 Pirie, John, M.D., 26 Elmbank cres. 1877
*a*Pirrie, Robert, 9 Buckingham ter. 1875
Playfair, David James, 7 Victoria crescent, Dowanhill. 1901
Pollock, A. Barr, 3 Belgrave terrace, Hillhead. 1897
*a*Pollock, R., M.B., C.M., F.F.P.S.G., Laurieston house, Pollokshields. 1883
710 Powell, James, Newlands School. 1900
Procter, Robert, Claremont, Alloa. 1901
*a*Provan, James, 92 West Nile st. 1868
Provand, A. D., M.P., 2 Whitehall court, London, S.W. 1888

Raalte, Jacques Van, Baltic Chambers, 50 Wellington street. 1884
715 Raith, James N. M., 4 Queen's square, Strathbungo. 1900
*a*Ralston, William Henry, 4 North Court, Royal Exchange. 1900
Ramsay, G. G., LL.D., Litt. D., Professor of Humanity in Glasgow University, 6 The College. 1900
Ramsay, William, 11 Wilton mansions, Kelvinside, 1899
Ramsey, Robert, 14 Park terrace. 1889
720*a*Ramsey, Robert, jun., 14 Park terrace. 1898
Rankin, The Rev. W. M., B.D., clergyman, 8 Craigpark, Dennistoun. 1900
Rankine, Adam, Russell, Macfarlane & Co., Ltd., 47 Queen street. 1901
Rankine, David, C.E., 238 West George street. 1875

Rattray, Rev. Alex., M.A., Parkhead Parish, 4 Westercraigs, Dennistoun. 1879
725 Rattray, William A., 233 Hope st. 1890
*a*Reid, Andrew Thomson, 10 Woodside terrace. 1900
Reid, David, 16 Cambridge street. 1887
*a*Reid, Hugh, Belmont, Springburn. 1880
Reid, James, 15 Montgomerie crescent. 1886
730*a*Reid, Joseph, 32 Newark drive, Pollokshields. 1901
*a*Reid, Nicholas M'Whirter, 40 Whitehill street, Dennistoun. 1901
Reid, Robert, C.A., 40 St. Vincent place. 1900
Reid, Thos., M.D., LL.D., 11 Elmbank street. 1869
Reid, William, M.A., 61 Grant street. 1881
735*a*Reid, William L., M.D., 7 Royal crescent, West. 1882
Reith, Rev. George, M.A., D.D., Free College Church, 37 Lynedoch street. 1876
Renton, James Crawford, M.D., L.R.C.P. & S.Ed., 1 Woodside terrace. 1875
*a*Rennie, John, Wellcroft, Helensburgh. 1901
*a*Renwick, Wm., Langgarth, Stirling. 1901
740 Rey, Hector, B.L., B.Sc., 2 Ailsa terrace. 1889
Richmond, Thos., L.R.C.P.E., 22 Holyrood crescent. 1887
Rigg, R. A., 95 Buchanan street. 1900
Ritchie, Geo., Parkhead Forge and Steel Works. 1890
Robb, George, carting superintendent, Caledonian Railway. 1901
745 Robb, John, Busby house, Busby. 1897
Robb, William, F.R.C.V.S., 6 Canning place, Stirling road. 1900
*a*Roberton, William, 209 Sauchiehall street, Glasgow. 1899
Robertson, Alex., M.D., F.F.P.S.G., 11 Woodside crescent. 1900
*a*Robertson, Henry Tod, Meadowbank, Airdrie. 1901
750 Robertson, John, Woodside school, and Endcliffe, Langside, *Hon. Lib.* 1860
Robertson, J. M'Gregor, M.A., M.B., C.M., 26 Buckingham ter., Hillhead. 1881
Robertson, Mure, M.E., 4 Clairmont gardens. 1897
*a*Robertson, Robert, B.Sc., M.Inst. C.E., M.I.E.E., etc., 154 West George street. 1900
Robertson, Robert H., Clyde bank, Rutherglen. 1888
755 Robertson, William, C.E., 123 St. Vincent street. 1869
Robertson, Wm., 15 Gordon street. 1900
Robinson, Rev. Alexander, M.A., B.D., Auchengray, Crieff. 1901
Robinson, Thomas, The Villas, Hurlet, Nitshill. 1901
Rodger, Anderson, Glenpark, Port-Glasgow. 1899
760 Roemmele, C. H., 34 Kelvinside gardens. 1900
*a*Rogers, John C., 224 St. Vincent street. 1888
Rose, Alexander, Richmond house, Dowanhill. 1879
Ross, Henry, 7 Park quadrant. 1876
Rose, Hugh, 26 Eglinton drive. 1900
765*a*Ross, John, 9 Westbourne gardens. 1885
Ross, John Munn, C.A., 115 Wellington street. 1894
Ross, Russell James, manager, Parkhead Steel Works, 8 Ashfield gardens, Jordanhill. 1901
Ross, William, 10 Regent place, Shawlands. 1893
*a*Rottenberg, Paul, LL.D., 105 West George street, *Vice-President.* 1872
770 Rowan, James, 22 Woodside place. 1897
Rowan, John, M.B., F.F.P.S.G., 9 Blythswood square. 1900
Rowan, W. G., 234 West George street, 1881
*a*Rowley, Thos., Campbell street, Govan. 1901
Rule, Robert, Jun., 7 Montgomerie crescent, Kelvinside. 1899
775 Runciman, Alex., 45 Renfield street. 1900
Rundell, R. Cooper, Underwriters' Room, Royal Exchange. 1877
Russell, Robert, M.E., Coltness Iron Co., Ltd., Newmains, Lanarkshire. 1901
Russell, Wm. F., 48 West Regent street. 1900

Salmon, W. Forrest, F.R.I.B.A., 53 Bothwell street. 1870
780 Samuel, John Smith, secretary to the Lord Provost of Glasgow, City Chambers. 1901
Sandeman, B., Ferndean, Lenzie. 1900
Sawers, William D., Assoc.I.C., 70 Barrington drive. 1894
Sayers, William Brooks, M.I.E.E., 189 St. Vincent street. 1890
Schmidt, Alfred, 508 New City rd. 1881
785 Scott, Alexander, M.D,, Waverley Lodge, Tollcross. 1900
Scott, Alex., 34 Lawrence street, Dowanhill. 1871
*a*Scott, D. M'Laren, 2 Park quad. 1881

Scott, John, 245 Sauchiehall street. 1892
Scott, Robert, I.M., 155 Wellington street. 1884
790 Scott, Robert, 8 Buchanan street. 1901
Scougal, Andrew E., M.A., 14 Kelvin Drive, Kelvinside, N. 1899
Seligmann, Hermann L., 59 St. Vincent street. 1850
Seligmann, Hermann Leo, Jun., 28 Renfield street. 1900
*a*Service, Edward, 92 St. Vincent street. 1901
795 Service, R. Gibson, 14 Royal Exchange buildings. 1900
*a*Service, William, 1 Queen's gate, Dowanhill. 1900
Sexton, A. Humboldt, F.C.S., F.I.C., F.R.S.E., Professor of Metallurgy, Glasgow and West of Scotland Technical College, 204 George street. 1892
*a*Shanks, J. B., 46 Gordon street. 1900
Shanks, John Cochrane, 26 West Nile street. 1899
800*a*Shaw, Councillor A. M'Innes, 8 Kelvinside terrace, N. 1900
Shaw, William, 17 Woodside crescent. 1900
*a*Shearer, Wm., 108 St. Vincent street. 1901
*a*Sherriff, George, Carronvale, Larbert, Stirlingshire. 1900
Shields, Daniel, 104 West George street. 1900
805 Simons, Michael, 206 Bath street. 1880
Simons, William, M.I.N.A., Sherbrook, Tighnabruaich, Argyllshire. 1900
*a*Simpson, J. C., M.D., 9 Marlborough terrace, Kelvinside. 1896
Sinclair, Alexander, Ajmere lodge, Langside. 1883
Sinclair, John, 150 Buchanan st. 1898
810 Sloan, George, 53 Bothwell street. 1900
Sloan, Samuel, M.D., 5 Somerset place.
Sloane, F. N., C.A., 187 West George street. 1893
Smart, William, M.A., LL.D., Professor of Political Economy, University of Glasgow, Nunholm, Dowanhill. 1886
Smellie, George, I.M., 167 St. Vincent street. 1880
815*a*Smith, Andrew, Miltonlea, Kilmalcolm. 1901
Smith, Colonel J. N., V.D., 2 Meadowbank crescent, Partick. 1900
Smith, D. Johnstone, C.A., 149 W. George street. 1888
*a*Smith, Fred J., 40 St. Vincent place. 1901
Smith, George, 1 Annfield terrace, East Partick. 1901
820 Smith, Hugh C., 55 Bath street. 1861
*a*Smith, J. Guthrie, 54 West Nile st. 1875
*a*Smith, James Murray, 11 Bute gardens. 1901
Smith, Patrick A., M.D., F.F.P.S.G., J.P., Dundrennan, 50 Queen Mary avenue, Crosshill. 1900
*a*Smith, Robert B., Bonnybridge, Stirlingshire. 1884
825*a*Smith, W.B., 34 Buchanan street. 1895
Snodgrass, J. F., Ashbourne, Winton drive, Kelvinside. 1900
Snodgrass, William, M.A., M.B., C.M., F.F.P.S.G., 11 Victoria cres., Dowanhill. 1890
*a*Somerville, Alex., B.Sc., F.L.S., 4 Bute mansions, Hillhead. 1888
Sorley, Robert, 93 St. Vincent st. 1878
830*a*Spencer, Charles L., Edgehill, Kelvinside. 1891
*a*Spencer, J. J., Edgehill, Kelvinside. 1895
Spens, John A., 169 W. George street. 1879
*a*Steel, William Strang, Philiphaugh, Selkirk. 1889
*a*Stephen, John, Domira, Partick 1880
835 Sterling, John Lockhart, 30 Ashton gardens, 1901
Steuart, Daniel Rankine, Osborne cottage, Broxburn, West Lothian. 1877
Steven, Alexander Kay, Westmount, Kelvinside. 1897
Steven, Henry, 20 Ingram street. 1900
*a*Steven, Hugh, Westmount, Montgomerie drive. 1869
840 Steven John, 32 Elliot street. 1875
Steven, J. H., Westmount, Kelvinside. 1897
*a*Stevenson, D. M., 12 Waterloo street. 1889
*a*Stevenson, Jas., F.R.G.S., 23 West Nile street. 1870
Stevenson, John, 41 Albert terrace, Trinity, Edinburgh. 1892
845 Stevenson, Robert, M.D., Labrador, Innellan. 1898
Stevenson, Wm., 13 Carlton place. 1888
Stewart, Allan Alfred, 180 Hope street. 1901
Stewart, Archibald, Marnock villa, Queen's drive, Crosshill. 1892
Stewart, David, 3 Clifton place. 1856
850 Stewart, Duncan, 14 Windsor terrace, Kelvinside. 1901
Stewart, John, 220 Parliamentary road. 1899
Stewart, Robert, Newark, Partick. 1899

*a*Stewart, Robertson Buchanan, 146 Argyle street. 1901
Stewart, Walter, Jun., M.A., B.Sc, Chief Assistant to the Profesor of Natural Philosophy, Glasgow University, Gartsherrie, Coatbridge. 1899
855*a*Stewart, William, Kelvinhaugh street. 1901
*a*Stobo, Thomas, Somerset house, Garelochhead. 1884
Stockdale, H. F., Clairinch, Milngavie. 1899
Stockman, Ralph, M.D., F.R.S.E., Professor of Materia Medica, The University of Glasgow. 1897
Stoddart, James Edward, Howden, Mid-Calder, N.B. 1872
860 Story, The Very Rev. R. H., D.D., Principal of the University of Glasgow. 1899
Strachan, George, Fairfield Works, Govan. 1900
Strachan, R.U., Sheriff-Substitute, 9 Crown terrace. 1896
*a*Strain, James M., 11 Hillend gardens. 1900
*a*Strain, John, C.E., 154 W. George street. 1876
865 Strathie, David, C.A., 162 St. Vincent street. 1895
*a*Sutherland, David, Royal Marine Hotel, Nairn. 1880
*a*Sutherland, John, Great Western Hotel, Oban. 1880
Sutherland, J. R., C.E., 45 John street. 1884
Swan, Charles C., 15 Rose street, Garnethill. 1891
870 Symington, Thomas, 94 Hope street. 1896

Tatlock, John, F.I.C., 13 Parkgrove terrace, West, Sandyford. 1875
Tatlock, Robert R., F.R.S.E., F.I.C., F.C.S., 156 Bath street. 1868
Taylor, Benjamin, F.R.G.S. 10 Derby crescent, Kelvinside. 1872
Taylor, J. M., Dean of Faculty of Procurators, Northbank, Kelvinside. 1900
875*a*Teacher, John H., M.B., C.M., 32 Huntly gardens. 1898
Temple, Edwin, B.A.Cantab., Rector of Glasgow Academy. 1899
Templeton, James, 2 Claremont terrace. 1900
Templeton, John Stewart, William street, Calton. 1900
Tennant, Sir Charles, Bart., 195 West George street. 1868
880 Tennent, Gavin P., M.D., 195 Bath street. 1875
Thom, R. Wilson, 8 Woodside terrace. 1898
Thomas, Moses, M.D., Superintendent, Royal Infirmary. 1890
Thomson, Alexander, M.B., C.M. (Edin.), 8 Hamilton Park terrace, Hillhead. 1900
Thomson, David, I.A., F.R.I.B.A., 2 West Regent street. 1869
885 Thomson, George C., F.C.S., 53 Bedford Road, Rock Ferry, near Birkenhead. 1883
Thomson, George, Tureen Street Public School. 1900
Thomson, Gilbert, M.A., C.E., 164 Bath street. 1885
Thomson, Samuel M., M.A., 208 West George street. 1900
Thompson, G. R., B.Sc., 204 George street. 1895
890*a*Thomson, James, F.R.I.B.A., 88 Bath street. 1886
*a*Thomson, James M., Glen Tower, Kelvinside. 1892
Todd, John Aiton, B.L., 190 West George street. 1897
Townsend, C. W., Crawford street, Port-Dundas. 1890
Trotter, John, 28 Gordon street. 1899
895*a*Tullis, David, St. Ann's Leather Works, Bridgeton. 1894
*a*Tullis, James Thomson, Anchorage, Burnside, Rutherglen. 1883
*a*Tullis, John, John street, Bridgeton. 1900
*a*Turnbull, John, Jun., M.I.M.E., 18 Blythswood square. 1883
Turnbull, Robert, 122 Wellington street. 1895
900 Turner, William, Barnfrow, Helensburgh. 1875
Turpie, John, 339 Sauchiehall street. 1896

Ure, William P., Regent Mills, Sandyford. 1893

*a*Waddell, Robert Davidson, Rednock, Kelvinside, W. 1901
Walker, Adam, 26 Newton place. 1880
905*a*Walker, Archibald, M.A.(Oxon.), F.I.C., F.C.S., 8 Crown terrace, Dowanhill. 1858
Walker, James A., 300 St. Vincent street. 1898
Walker, John Allan, Art Master, Allanbank, Abbey Drive, Jordanhill. 1901

Walker, J. W. O., 63 Montgomerie street, Kelvinside. 1896
*a*Walker, William H., Cardarroch House, Airdrie. 1900
910*a*Wallace, Hugh, Bank of Scotland, 544 St. Vincent street. 1879
Wallace, James W., M.D., C.M., Cairnsmore, 67 St. Andrew's drive, Pollokshields. 1900
Wallace, James Wilson, M.D., C.M., Cairnsmore, 67 St. Andrew's drive, Pollokshields. 1900
Wallace, William, M.A., LL.D., barrister-at-law, 36 Lilybank gardens, W. 1900
*a*Wallace, Wm., M.A., M.B., C.M., 25 Newton place. 1888
915 Wardlaw, Alex., The Clydesdale Bank, Ltd. 1900
Warren, John A., C.E., 115 Wellington street. 1887
Watkinson, Wm. H., Whit. Sch., M.Inst.,Mech.E., Professor of Steam and Steam Engines in the Glasgow and West of Scotland Technical College, The Pines, Crookston. 1893
Watson, Archibald, 5 Westbourne terrace. 1881
Watson, George Louden, 109 Hope street. 1901
920 Watson, Harold, 9 Holland place. 1901
Watson, James, 6 Kirklee road, Kelvinside, W. 1873
Watson, John, National Bank, Crosshill. 1900
*a*Watson, John, 205 West George street. 1886
Watson, Joseph, 225 West George street. 1882
925*a*Watson. J. Robertson, M.A., Professor of Chemistry, Anderson's College Medical School, Dumbarton road. 1891
*a*Watson, Thomas Lennox, I.A., F.R.I.B.A., 166 Bath street. 1876
Watson, William, Gartmore, Langside. 1897
*a*Watson, William W., 5 Westbourne terrace. 1899
Watt, Alexander, 183 St. Vincent street. 1900
930 Webster, Councillor H. Carvick, 48 Montgomerie drive. 1900
Webster, Rev. John M'Kessor, M.A., The Manse, Row, Dumbartonshire. 1901
*a*Weir, William, Shewalton, Dreghorn. 1901
Welsh, John M., Ph.D., F.E.I.S., F.R.G.S., 115 Ledard road, Langside. 1897
Welsh, Thomas M., 3 Prince's gardens, Dowanhill. 1883
935 Wenley, James A., 5 Drumsheugh gardens, Edinburgh. 1870
White, J. Walls, M.D., Brunalb, Uddingston. 1900
White, John, Scotstoun Mills, Partick. 1897
Whitelaw, William, Hope Cottage, Crookston. 1897
Whitson, Arthur, 77 St. Vincent street. 1901
940*a*Whitson, Jas., M.D., F.F.P.S.G., 13 Somerset place. 1882
Whyte, A. C., L.D.S., 42 Dundas street. 1892
Whyte, John Laurie, 5 Mansion House road, Langside. 1900
Wield, John, 9 Barns street, Ayr. 1895
Williamson, John, 65 West Regent street. 1881
945 Wilson, Alex., Hydepark Foundry, 54 Finnieston street. 1874
*a*Wilson, David, M.A., D.Sc., F.C.S., Carbeth, Killearn. 1898
Wilson, Thomas, 142 West George street. 1901
Wilson, Thomas F., 129 St. Vincent street. 1901
Wilson, Walter Stuart, 4 St. John's terrace. 1901
950 Wilson, Wm., F.E.I.S., Schoolhouse, Pavenham, Bedford. 1889
Wingate, Arthur, 10 Prince's gardens, Dowanhill. 1882
Wingate, Walter E., 4 Bowmont ter. 1880
Wood, Adam, Portland villa, Troon. 1901
Wood, James, Dunard Street Public School, 2 Cresswell terr., Uddingston. 1900
955 Wood, James, M.A., Glasgow Academy. 1885
*a*Wood, Wm. Jas., 38 Cochrane street. 1893
Woodrow, Alexander, 75 Glassford street. 1900
Woodrow, Alexander Norie, 75 Glassford street. 1900
*a*Workman, Chas., M.D., F.F.P., & S.G., Professor of Pathology, St. Mungo's College, 5 Woodside terrace. 1898
960 Woyka, John William, 241 Govan street. 1901
Wright, Robert Patrick, Professor of Agriculture, West of Scotland Agricultural College, 6 Blythswood square. 1895

Wylie, William A., 13 Woodside terr. 1901
Wyper, James, Nithsdale Lodge, Pollokshields. 1900

Yellowlees, D., M.D., LL.D., Physician-Superintendent, Gartnavel. 1881
965 Youden, John, 12 Bothwell st., Glasgow, and Hazelwood, Giffnock. 1901
Young, Alfred A., M.A., M.B., 10 Hamilton Park terrace. 1899
Young, David, M.D., Linton Villa, Tollcross Park. 1900
*a*Young, James, jun., Caerleon, Bearsden. 1900
*a*Young, John E., 24 Belhaven terrace, Kelvinside. 1900
970 Young, John, merchant, 8 Athole gardens, Kelvinside. 1900
Young, John, 42 Bath street. 1900
Young, John, 2 Montague terrace, Kelvinside. 1885
Young, John, 88 Renfield street. 1881
*a*Young, John, jun., M.A., B.Sc., 61 Clyde street, Anderson. 1887
975 Younger, George, 166 Ingram street. 1847
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